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ORANGE CULTURE.

A

TREATISE ON THE CITRUS FAMILY,

BY GEORGE GALLESIO,

AUDITOR OF THE STATE COUNCIL, AND SUB-PREFECT OF SAVONA.

TRANSLATED FROM THE FRENCH, EXPRESSLY FOR

“THE FLORIDA AGRICULTURIST.”

Jacksonville, Fla. :

PUBLISHED BY CHARLES H. WALTON & CO.

1876.



THE

FLORIDA AGRICULTURIST.

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CHAS. H. WALTON & CO., Publishers,
Jacksonville, Fla.

Edward J. Wickson.

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PUBLISHER'S PREFACE.

While bringing before the public this learned work of M. GALLESIO, the translators were impressed with the fact that in some parts it might not be clear to the unscientific reader; they have, therefore, ventured to simplify and to explain botanical terms, and in some few cases geographical names.

The translation of this work was begun by Prof. S. D. WILCOX. His death occurring when but one-fourth of it was accomplished, we are consequently indebted to a friend for the completion of the task. Any discrepancy in the style of writing may be thus accounted for.

AUTHOR'S PREFACE.

Of all the plants spread by Nature upon the surface of the globe, there are none more beautiful than those we know under the names of *citron*, *lemon*, and *orange* trees, which botanists have included under the technical and generic name of *Citrus*. These charming trees are both useful and ornamental. No others equal them in beauty of leaf, delightful odor of flowers, or splendor and taste of fruit. No other plant supplies delicious confections, agreeable seasonings, perfumes, essences, syrups, and the valuable acid so useful to colorers.

In a word, these trees charm the eye, satisfy the smell, gratify the taste, serving both luxury and art, and presenting to astonished man a union of all delights.

These brilliant qualities have made the *Citrus* a favorite in all countries. In warm climates it is the object of careful culture, and in more temperate climes it is the necessary ornament of country-seats and villas, while, still further north, it has originated those inventions in building designed by luxury to make a summer in the midst of winter. Writers upon agriculture have occupied themselves with the cultivation and description, and with all tending to the preservation, propagation, and uses of these trees.

Etienne, Serres, and others in France; Gallo, Tanara, Trinci, and Ferraris in Italy; Herrara in Spain; Miller in England; Commelyn in Belgium; Volcamerius and Sieler in Germany, have all written upon these plants. Volcamerius and Ferraris have added to their books numerous drawings of the varieties known in their time, thus seeming to leave nothing to be desired on this subject. But, after close study and thought, I have found great confusion and want of method in their classification. This is owing to the prejudices among writers concerning the nature and origin of *varieties*. I have, therefore, devoted myself to the close observation of these plants, examining their caprices from their birth to their fruiting, and, seconding

Nature by culture, not forcing her by the graft, I have been able to obtain many results, and to compare them with preceding phenomena. I have, also, attempted experiments in order to find the secret cause of these results. I have operated upon the flowers of the citrus, watching them from the moment of conception, in their development, in their fructification, and in reproduction from their seeds.

Upon observations and their consequences I have based a theory by which I have arranged my classification, definitely fixing, by decisive experiments, the species, the chief varieties, many hybrids, and nearly all the monsters. This theory I have elaborated in the first chapter of this work, and in the second I have shown its application to the *citrus*. The third chapter offers a comparison and description of all these beings. The monsters of the genus *citrus* have also furnished me an article in this chapter, to which I have added remarks upon the species of India. Finally, the history of the *citrus* has been the subject of my fourth chapter. My chief design has been to throw light upon the physiological problems that I have tried to solve. To this end I have sought to determine the different climates in which these species were placed by Nature, and to discover by what degrees and in what manner they were spread, mingled, and naturalized in the countries where we now see them. I have endeavored to spy out the circumstances and causes which gave birth to the crowd of varieties, or which have made them disappear.

For the title to my book I have preferred the botanical name of this genus, discarding, as savoring of the fabulous, the term *Hesperides*, so often used by my predecessors. I also use, in the course of this work, the ancient Italian word *Agrumi*, which comprehends all the species of this family. It is thought that this word was borrowed by the writers of the sixteenth century, from the Arabs, who called their fruits by a term denoting their acidity. It is certainly a name well chosen to distinguish this genus.

A TREATISE ON THE CITRUS FAMILY.

BY M. GEORGE GALLESIO,

Auditor of the State Council, and Sub-Prefect of Savona.

CHAPTER I.

THEORY OF VEGETABLE REPRODUCTION.

ART. I.—*Of the Citrus—Of its species—The intermediate races which unite them—The researches concerning the formation of new plants—The discovery of hybrids—The uncertainty respecting the nature of varieties.*

The Citrus proper has been for a long time the only species of Agrumes known to Europeans, and has thus furnished botanists the name of the genus to which they have referred all the species, and consequently the varieties also with which our gardens have progressively been enriched.

But among all these different races there have always been distinguished four, whose physiognomy is so marked, and whose characteristics so distinct, that it is impossible to regard them as other than the principal species into which the genus is naturally divided.

The first is the Citron, which has preserved the generic name of *Citrus*.

The second species is the Lemon, wrongly called *Citrus medica*, but properly *Citrus limon*.

The third and the fourth are commonly known as the Sweet and Sour (Bigarade) orange, and have been united by botanists under the common name of *Citrus aurantium*.

These four species have been almost infinitely multiplied by a chain of varieties, and have been crossed and confounded in such a manner that at the present time they are so united one to the other by an insensible and continuous gradation that it is very difficult to distinguish them. They are also multiplied in appearance more than in reality by the different names which these varieties have received from the botanists of different countries, as well as by the disappearance of several varieties once known, and the formation of several new ones.

In the midst of this confusion, which would very naturally exist as to the varieties, they should nevertheless have agreed concerning the species, which has always presented characteristics not to be mistaken.

But botanists have never occupied themselves carefully with these secondary divisions, and satisfied with having classified the numerous genera of vegetables, they have regarded the different races sometimes as species and sometimes as varieties, without even determining the characteristics by which nature has distinguished these two analogous but different classes of the vegetable kingdom.

They long disputed to ascertain whether the

earth has produced new species of plants since the creation, or whether all which now exist were created at the beginning of the world.

This question, discussed with so much erudition and sagacity, appears to have been decided since we have discovered the secret of the combination of the species by means of the fructifying pollen which passes from one plant to the others; and it is no longer doubtful that nature, rich in her productions, has arranged a kind of marriage between plants differing a little, from which it results that a new plant is produced, distinguished by the name of hybrid.

The discovery of these vegetable mules, which form in nature a class not originally existing, has thrown much light upon and infinitely facilitated the classification of species.

But it still remains to determine the nature and discover the origin of the third race of vegetables, which cannot be ranked among the hybrids because they belong only to one species, but are nevertheless so different from each other and from the primitive type that we must regard them as distinct beings, having their own peculiar characteristics.

It is principally upon these numerous races, known under the name of varieties, that the opinion of botanists and cultivators is still divided. The hypotheses hitherto formed concerning their nature and formation are so vague and unsatisfactory that it is important for science that light be thrown upon this mystery, and that an explanation of it be given more in harmony with the principles of vegetable physiology. We will begin by examining the opinions held upon this subject.

ART. II.—*Opinions of botanists and agriculturists respecting the origin and cause of varieties and monsters.*

When we regard the variety always reappearing in the productions of the vegetable kingdom, and observe the innumerable multitude of new beings by which the surface of the globe is continually enriched, we are tempted to believe that nature has abandoned to a number of external agents, either natural or artificial, the power of modifying her productions and infinitely varying them.

But when we study vegetable life, and examine closely all its changes and mysterious reproductions, we are persuaded that nature, always regular in her operations, always grand in her results, has abandoned nothing to chance, and that she has determined from the moment of creation all

the details of existence, and cast inflexibly the mold in which all beings must be modeled.

This great truth, which cannot be hidden from the view of the careful observer, nevertheless seems to be with difficulty reconciled with a number of phenomena which are every day presented to view.

On the other hand, we are reassured in these principles by the example of all the primitive species of plants, which are always met with on the earth in the same form under which they have existed for many centuries; we are convinced of this fact, by the bringing together and comparison of those remains of plants found in excavations, and by the models which have been transmitted to us by painting, sculpture, or descriptions of the ancients.

On the other hand, we know not to what should be attributed all those new species or varieties, of which, it seems, our ancestors had no idea, and still more those sub-varieties and those monsters which are daily developed under our own eyes, either by the seed, or some chance, of which we as yet know not the principle.

It is already half a century since we succeeded in establishing order in the multitude of these new races, which have been divided into two classes. The first is the *hybrids*; the second, the *varieties*.

Linnæus has wrung from nature the secret of the formation of the first; it remains to seek the principles according to which the second are produced.

I will call the hybrids by the name of the species entering into their formation, because it seems to me that every individual which deviates partially from the characteristics of its type, and participates in the properties of another species, is something more than a variety, and I will reserve this last name for those new plants whose secondary characteristics are modified by any cause whatever without departing from the species.

Without this distinction I would be embarrassed in determining, for example, to what species, in quality or variety, the hermaphrodite orange belongs (*Citrus aurantium indicum limocitratum, folio et fructu mixto*), which partakes of the lemon, the orange, and the citron, and it would necessarily follow that this pretended variety would be found ranked in the same line as the blood-red orange tree (*Citrus aurantium sinense hierochunticum fructu sanguineo*) which has only the characteristics of the single orange of which it is a variety.

I will not stop to trace the theory of the hybrids. This system is already so well known that I can add nothing to its development. I shall occupy myself in seeking the cause of the formation of varieties, and will present my theory as the result of many experiments and much observation, which I invite botanists to repeat in order better to determine their phenomena and their consequences.

In all times it has been observed with astonishment that nature appears more inclined to give us wild than fine varieties. It is rare that a choice fruit is reproduced from the seed; and we see, for example, that the seed of the most delicate butter pear regularly gives us only wild fruit, whose acid fruit, without juice, in no way

resembles the species from which it is descended.

Even when chance procures us some fine variety, it is nevertheless not always equal to the fruit that has produced it, and as this chance seldom occurs, and as it is very difficult to establish such recurrence, because it is not foreseen, and because it has fallen but little under the eyes of enlightened cultivators, it has generally been believed that these varieties are due only to the graft, to cultivating, or to the climate. Sometimes, indeed, botanists have allowed themselves to be imposed upon by superficial and deceitful gardeners, who, seeing themselves the possessors of several of these new species without knowing their origin, have imagined and believed that some marvellous operation has taken place, and supposed them due to grafts, which existed not in nature, and which would not give such a result if they did exist. Hence the different agricultural systems which have reigned for several centuries, and of which a part reigns still to-day, even among enlightened agriculturists.

There are, for instance, few cultivators who are not convinced that the sour orange is the type of the species, and that all seed from an orange tree, even though it be a sweet one, gives only sour orange trees. This pretended phenomenon, which has been believed on the faith of the cultivators, without ever being determined by exact experiments, has been generalized respecting almost all fruit-bearing plants; and it has been established, as was supposed, in principle, that the wild fruit was the type of the species, and that fine fruits, being only individuals improved by art, could produce by their seeds only the type of which they are the conservators, or, in other words, individuals in a state of nature known under the name of wild plants.

Other agriculturists have imagined that the seed of the sweet orange produced sour or bitter orange trees only when taken from a graft of the sweet orange placed upon the sour orange tree, and this system has been extended to the other species of fruit, such as the apple, peach, pear, and other trees. They have, perhaps, been forced to this modification in the theory of artificial improvement by the example of some individuals of choice fruit which they have seen to be produced from the seed, and as they could not conceal the truth of these accidents, and as they saw, moreover, that such a case but rarely occurred, they imagined that those fruits which reproduced without degeneration when taken from a seedling, lost that property whenever they were taken from a graft on a wild tree; and they even deluded themselves so far as to believe that the pericarp followed the nature of the graft, while the seed followed the nature of the tree receiving the graft.

All these prejudices have prevented cultivators from adopting the method of multiplication offered by nature, and, persuaded that the seed could give only a wild product, they have condemned all seedlings to be grafted.

But these artificial methods only preserved the species already acquired. They multiplied the individuals but never renewed the race, and consequently it still remains to be discovered in what manner those varieties were obtained, which they could not deny were unknown to our ancestors. In order to satisfy this natural inqiri-

tude of human curiosity they sought in cultivation the solution of this problem. In vain did experience disprove this system. They went beyond our record and remembrance, and hid in the obscurity of antiquity the ignorance of an origin which they were forced to admit must be sought after the creation.

This theory, nevertheless, could not be sufficiently satisfactory to explain the origin of some new races which they had seen appear in gardens under the eyes of their contemporaries.

The graft and the slip (cutting) then came to the assistance of cultivators. They commenced by believing that the subject or stock grafted can sometimes influence the grafted bud in modifying its juices, and they imagined the existence of extraordinary grafts which, uniting very different species, seemed destined to produce new races having the characteristics of both.

Others attributed these marvellous fruits to some capricious combinations formed by the union of two buds. Others finally established, in substance, that by the single fact of the graft being repeated several times on the same individuals an improvement in the plant was obtained.

There have been agriculturists who thought themselves able to change or modify the taste of vegetable productions either by infusing the seed in substances sugared or aromatic, or by the introduction of these substances into the pith of the plant; and the ill-success of these operations was always attributed to a defect in the manner of proceeding rather than to an insufficiency of the means employed.

It is to these different methods that have been attributed all the phenomena of the vegetable system, of which the cause was not understood.

Thus it has been believed, and is still believed perhaps, that the absence of spines and down belonging to certain vegetables is only the effect of the change of climate, of long cultivation, or of the graft.

In like manner, to the multiplication by slip or by layer, the loss of the pistils of certain plants, and the sterility of certain fruits have been attributed, in which fruits it was believed that this method of multiplication acts to obliterate the female parts and to increase the volume of the fruit. The lack of proofs was hidden in the necessity of following those methods during a succession of several generations, and the system was supported by the example of several sterile plants, such as the Persian lily, the snow-ball, the syringa, and many other ornamental bushes; and on that of the barberry bush, the medlar tree, without seeds, &c. This theory could not, it is true, be extended to annual or biennial plants which the seed produce every year, and in which we so often see examples of sterile flowers. But they found in their principles a very plausible explanation of sterility, and they attributed the double and semi-double flowers to the force of cultivation, imagining that this agent, aided by surrounding substances, occasioned the transformation of the fructifying parts into petals.

Finally, wishing to give an explanation of those monstrosities which the vegetable world constantly presents, they regarded them as diseases produced by exterior causes which they have

never determined, and they attributed to these unknown causes the variegated coloring of flowers and the diversified foliage of trees, together with the extraordinary forms of those fruits which offer excrescences in the pericarp, or other similar phenomena. All these opinions have reigned for centuries among agriculturists, and it is but recently that they have begun to forsake them. It is certainly interesting to discuss them, and important to establish or refute them. This is the task which I have undertaken. I have employed my leisure in examining them with the principles of a severe philosophy, and submit them to the analysis of observation and experience. The first fact which it was necessary to examine was to know if wild trees existed which the graft or culture has changed into fine varieties. This question holds the solution of a problem of vegetable physiology which appears not to have hitherto occupied the learned, viz.: What is the influence of these agents (the graft and cultivation) on vegetables?

ART. III.—Influence of the graft upon vegetables.

It must certainly be acknowledged that the graft as well as the culture and soil may influence the development of vegetable organs. A grafted tree is an individual forced to live upon a stock not its own, but from which it must draw its nourishment, so that only the subject of the graft can be assimilated to the soil. If its organs are adapted to furnish the graft all the aliment of which it can make use, then the graft will take on an extraordinary growth, which it would not have equalled on a less thrifty stock. If the stock which bears it be unable by its organization to supply the food it needs, then will it remain meagre and spindling.

These different circumstances, as well as the culture, may produce the phenomena presented by the wild service tree (*Sorbus Aucuparia*), which, grafted upon the hawthorne, (*Mespilus Oxyacantha*) grows, it is said, with more than usual rapidity, and attains more than its wonted height and fruitfulness. Also that of the wild apple, which, grafted upon the paradise apple, becomes a slender shrub whose branches grow hardly ten feet high.

These phenomena are due only to the abundance or lack of nourishment, and present no other effect than a greater or less development of the different parts of the plant. We remark one thing still more striking in ordinary grafts. Every grafted plant appears to display, at least for a time, a luxuriance of foliage more marked than the seedling, for instance, if the graft has been put into an individual of this nature; but this is due to a very simple cause. The seedling develops many branches. It gives fruit generally once in two or three years, and when it does bear, the tree is so loaded down that it can only nourish them all with difficulty. From the time it is grafted several changes are effected. Its plump and bushy top disappears and is replaced by a single branch, which has for its own nourishment all the sap which supported that large quantity of foliage. To be sure the graft may enlarge afterwards, but it never replaces the quantity of branches which crowned the original tree. A grafted tree is always less large and

bushy, and hence the foliage is better nourished and more beautiful, and its fruits, which are less abundant, are of greater size and more agreeable flavor.

Another circumstance also influences, perhaps, the greater elaboration of fruit in the grafted tree.

The graft unites a branch of one variety to a stock of another variety. This union, which is not natural, forms always a kind of knot at the point of insertion, which may check the rapidity of the flow of sap; and we know that on account of this slowness in the current of the sap, buds fed by it produce fruit rather than branches.

A tree which bears but little may be rendered fruitful by rubbing off the bark at its foot. The cultivators of vineyards bend the vines or break them a little at the place where they wish the fructification to commence; and I have several times obtained oranges of extraordinary size by twisting the branch which bore them.

All these means have been long known to cultivators, and it is no longer doubtful that this effect is due only to the great slowness in the flow of the sap, which thus influences the quantity and quality of the fruit.

But such are the limits which nature has fixed to the influence of the graft upon vegetables. It facilitates or improves their development, but never changes or modifies their forms, juices, or colors. Never has the wild pear been transformed by the graft into the butter pear, nor the butter pear into the muscat pear; never has the bitter orange been so improved as to lose its bitterness by grafting. I have a stock of this species which I have grafted three times upon itself, graft upon graft, but it gives me only larger fruit, differing in no other way from that of the plant which furnished the bud.

The graft is nothing more than a kind of slip. It transfers the bud of one plant to the stem or body of another; and this bud, which encloses within itself the rudiments of the vegetables destined to grow from it, draws from the stock on which it is placed the juices necessary for its nourishment in the same manner as the slip draws them directly from the earth. It is possible that, from the passage which these juices are forced to make through the roots and trunk of the plant, they reach the fibres of the bud more elaborated than if drawn more directly from the soil; but whatever may be their condition when they enter the bud, they are there always modified by its organs as are those elements drawn from the air, and as those taken from the earth would be, if it were placed with its own roots directly in the soil.

Experience has confirmed these principles, and it is now established that the graft is useful only in perpetuating species or varieties without improving them. I have made constant observations on this subject during more than fifteen years, by keeping beside the grafted plant the plant which furnished the bud. I have grafted oranges upon lemons and lemons upon oranges. I have grafted sweet oranges upon bitter oranges and bitter oranges upon sweet ones; apricots on prunes and peaches upon apricots; and I never could recognize the least difference between the fruits given by the plant which furnished the graft and those of the plant which received it. I never obtained from these operations any other

result than that of preserving rare varieties, which could not be propagated by seed, for the double reason that they but rarely contained any, and that when they did, we could obtain from them usually only degenerated varieties.

The theoretic principles which prove the insufficiency of the stock and of the sap to effect changes in the product of the graft, can not be equally applied to those remarkable grafts formed by the union of two or three buds, the manner of which occurrence is described in the works of ancient writers upon agriculture, and to which it is still pretended mixed species are due, such as the *orange de bizarrerie*, which partakes of the character of the orange, the lemon, and the citron.

We have great difficulty in conceiving how two half buds, applied the one upon the other, can amalgamate and form one single bud partaking of the nature of the two. I would not dare cite my experience to prove that two different buds united together inserted upon an analogous stock, or even placed in the earth, perish if too much mutilated, or develop, each one separately, its scion.

The ill success of these operations would be only a negative proof, which could not destroy the facts if any existed; but I challenge the gardeners to cite me an example, supported by impartial observations, whose exactness they can guarantee. Moreover, if in presenting me such an example they offer me only such individuals as those I possess, and such as I have seen in Liguria, in Tuscany, and such as are known in France under the name of *orange de bizarrerie*, I would venture to contradict them respecting it.

The anatomy of the tissue of these individuals would furnish me an irresistible argument. This tissue does not present traces of three buds to whose unions the hybrid is pretended to be due. It shows only a branch which bears at one time, but isolated under distinct leaves, buds of three species and buds which give mixed fruit, without, however, enabling us to recognize in these species of embryos anything announcing this mixture.

I will not speak of those imaginary grafts by which some have pretended to make branches of the fig, grape, rose, and jasmine grow on orange and lemon stocks. I have several times seen such phenomena in Tuscany and Milan, and confess to have been deceived by them; but having been a long time cheated by those gardeners, who sold at exorbitant prices ridiculous recipes for obtaining these extraordinary unions, and after having lost, by making trial of them, several orange stocks, I finally succeeded in discovering the fraud, and am convinced that these heterogenous unions do not exist in nature. I bought a vase containing an orange stock on which a fig scion seemed to be grafted. As soon as I got possession of it I opened the stock where the fig branch was inserted, and discovered that this stock was hollowed out inside, and that through this hole in the interior the would-be graft found its way to the soil, thus living upon its own root instead of that of the orange tree. This discovery completed my conviction that a difference really exists in the organs of different vegetables as well as in the organs of animals, and that from this difference of organization the difference of products results. I know that in

the vegetable kingdom details escape the observation of the physiologist, and it is extremely difficult to give some of the comparative anatomical appearances of vegetables, but it is for this reason no less true that differences may exist and be as unchangeable as in the animal kingdom. Every species has its determined forms, which may be destroyed but not modified, and whatever the nature of the stock which nourishes the plant, it will always give the product proper to its species.

ART. IV.—*Influence of culture and soil on plants.*

Culture and climate have appeared to many writers more powerful than the graft, and they have attributed to them the very decided changes in the secondary characteristics of trees. It is principally to the force of culture that they attribute the sensible difference existing between the wild and cultivated trees. But it is easy to see that this is a mistake in their judgment, and that they attribute these differences to culture or the graft, merely because these are the processes which always accompany the individuals—which undergo a change and become improved fruit, and because these are the means of multiplying the number of the improved individuals. Whereas these are mere *accidents*; they have, because constantly used, been considered the causes of the changes in the fruit.

Nature gives some trees which bear ordinary fruit and others which bear fine fruit. The first, always being grafted when in our gardens, bears its own peculiar wild fruit only when found in the woods; and the cultivator who sees them there in a degraded condition concludes that this degeneration is due to the want of cultivation. The trees bearing fine fruit, being seen only in a state of cultivation, and multiplied by the graft only, the cultivator, ignorant of the origin of their ancestors, judges that they owe their improvement to the graft and the culture which they have undergone. I say the cultivator judges in this manner on account of this ignorance of the first original tree which gave these different results which he observes; because there has never existed a writer, to my knowledge, who has carefully noted how one of these changes has occurred. They all speak of the changes and note the difference which exists between those individuals found in the woods and those found in the gardens, but no one has seen this change take place on one and the same individual. I say all see it through the dimness of ages, and their conclusion is the result of conjecture rather than of observation.

But a close and continuous attention to nature will show that these differences, which exist in two distinct individuals, as, for instance, the pear of the forest and the pear of cultivation, never appear successively on the same individual. I call an individual the plant which exists on its own stock, and which enjoys the life given it by Nature, and I also term an individual the collection of all the plants which proceed from a single germ, and consequently form only one single plant, which may be multiplied without changing its character, either by passing successively on to an infinite number of stocks as a graft, or by forming by means of slips an infinite number of stocks

of its own, having a root in the earth, and prolonging in this manner its own life, as well as that of the species, and thus varying infinitely the places and modes of its existence, but always bearing in itself the principles of organization received in its conception.

The individual which perished on the root where it germinated, and that which renews for the millionth time, it may be, its life, in a graft or a slip, have a single and common origin, and hence are one and the same individual. This individual, though infinitely multiplied, will always bear in the numberless subdivisions of its being the same characteristics and the same aspect which it had in the beginning. To illustrate, take the sugar-cane. In India, beyond the Ganges, there are several varieties of this plant which are propagated by seeds, but in San Domingo, where it is reproduced by slips, only one variety is known. It has been cultivated there since 1606, with different methods and a variety of soils, and still remains unchanged. Neither the processes of cultivation nor the difference in soils have improved it in the course of two centuries, and the only reason why it has not degenerated is because it has always been multiplied by cuttings.

This fact is perfectly in harmony with the theory of the manner in which culture affects vegetables. Nutrition is the most powerful means by which they can be influenced in cultivation. The nourishing juices, of which the earth is the principal vehicle, are everywhere of the same nature; chemistry has proved that the same elements unite to form the acorn in the oak tree, and the orange in the orange tree. It is in the different organs of the *diverse genera* of vegetables that these same principles are decomposed, elaborated, and finally acquire forms and properties widely different from each other.

Now, can we suppose, without wounding the principles of sound philosophy, that this passive material, which is designed only to receive modifications from the different agents by which it is elaborated and used—that this can react upon those organs or agents and change their existence, a work so marvellous that Nature only can perform it?

It has been held that the multiplicity of petals, which form double flowers, and the certain lustiness of some varieties are due to a superabundance of nutrition. But this formation of petals is not the simple development of a principle pre-existing in the flower. It is a real change of the male and female parts into corollas; and the luxuriance of these beautiful varieties bears in the leaf and in the fruits new forms, which distinguish them from others and constitute them distinct races.

Nature has fixed for all races a maximum and a minimum of development which no cause can surpass. When a plant has little nutriment it becomes feeble and languishes, but it will die before departing from the characteristics of its species. If well nourished it attains the maximum of its growth, but if engorged it refuses the superabundance, or, if forced to absorb, it is injured; its canals are blocked up, its organs affected, its vital functions changed, and it perishes. The facts we possess are in harmony with these principles. We find double flowers only in species which are multiplied by seed. Those

propagated by slips or the graft never present this phenomenon. We never find it in the jasmine, the hortensia, nor in any of those exotics which in our climate yield no seed. But they are certainly cultivated with as much care as roses, hyacinths, or carnations; but they never present the caprices of these beautiful varieties, which reappear every day in our gardens under new forms and with a mixture of the most charming colors. The error of these cultivators has been still more extraordinary in regard to sterility of plants, which they have attributed to the mode of propagation by slips or by layers. All these opinions could result only from erroneous reasoning.

We have already seen that—having observed that plots of ground were covered with choice varieties while the woods were full only of wild ones—it was inferred that it was culture which had changed the savage varieties to fine ones, so that these last are now called domesticated varieties. In this case of the sterile plants—having observed that they were multiplied only by the slip and the layer, it has been inferred that it was the mode of propagation which effected in the plant subjected to this operation for several generations, the insensibly gradual loss of its stamens and pistils, and finally produced sterility. Here it is easy to see the effect has been taken for the cause. These plants have been considered sterile because propagated by the cuttings, whereas the contrary is true, and they are propagated by the cuttings because they are themselves sterile; otherwise it would follow that all plants multiplied by the slip would be sterile, which is not the case. Examples might be given in abundance of plants bearing fertile seeds, which have long been multiplied by the cuttings, as the olive and the grape; and a great number of superior varieties are produced by the slip only to keep them from degenerating.

But the most conclusive proof of the futility of this belief is the fact that these plants of sterile flowers all have their type, which is not sterile, and whose seeds have probably given the sterile variety which has been multiplied by cuttings. Indeed, we sometimes find this variety in the woods, where nature certainly has used no grafting knife, as, for instance, in the sterile snowball (*viburnum opulus sterilis*) beside the *viburnum opulus* or snowball of fruitful flower.

I shall not occupy my time in discussion upon the influence of infusions of sugary substances and other similar processes by which all the ancient writers pretend to change the taste and color of fruits; all these notions are now relegated to the books on agriculture of the seventeenth century, and there is no cultivator, however little enlightened, who is not convinced of their uselessness.

Besides, these errors cannot but disappear from the moment that we are convinced that nutrition (by which means the cultivation of the soil acts upon plants or trees,) influences only their simple developments, but that forms, colors, properties, can only be changed by the seed.

Such is the march of nature in all the chain of organized beings. Generations vary infinitely, but individuals never change. The negro and the white man give rise to numerous mulattoes,

but the negro transported to the eternal snows of the North will suffer no change any more than will the white man under the burning sun of Africa. The giant will procure his stature amid the most cruel want, and the dwarf will never change his proportions, though supplied with the most nourishing food. Nature has determined the forms of all beings; she has fixed the principles of their organization in the embryo, and nothing can alter them. They resist every force that surrounds them, and ever preserve, amid the continual variation of nourishment and soil, the original impress received from the hand of Nature.

ART. V.—*The reproduction of plants by the seed.*

The seed is the only source of varieties in vegetables. It is only by this means that nature effects those wonderful transformations every day witnessed, but too little understood. The majority of cultivators acknowledge this fact; and even those who attribute beautiful varieties to culture also agree that many are furnished by the seed.

We propose, by the following experiments recorded by a French naturalist of great experience, to show the results of reproduction by seed.

Experiment I.—I sowed, during several years, seeds of the china orange (*citrus aurantium sinense*), of a fine shining skin. I always obtained sweet orange trees, of which a part bore oranges of a thick, rough skin, and a part beautiful fruit of a skin still finer than the original which furnished the seed. The same thing occurred in the sowing of ordinary oranges of thick and rough skin—there grew up several trees of beautiful fruit, and one stock, whose leaves were like shells in shape, but the fruit very ordinary and seeds few, and even those very poor.

I made the same experiment with the peach tree; seeds from peaches borne on the same tree gave several varieties, for the most part of ordinary fruit, but a few finer than the original planted; but the stones never gave a cling-stone peach, nor a cling-stone the ordinary fruit.

The almond gave the same result. Sweet almonds produced only sweet almond trees. There was some difference in the hardness of the shell, but I never obtained a single bitter almond.

Experiment II.—I sowed seeds of the red orange (*citrus aurantium sinense, hierochunticum, fructu sanguineo*). The trees which came from these produced only ordinary fruit of orange color.

Experiment III.—I sowed lemon seeds taken from fruit gathered in a garden where lemon and citron trees grew together, and obtained many trees, whose fruit presented a series of varieties, from the lemon to the poncire, but the larger part of them were simple lemons. Those having the characteristics of the poncire produced no seeds!

Experiment IV.—During a long series of years I sowed seeds of the sweet orange, sometimes taken from seedlings, sometimes from seedlings grafted on a sour orange stock or a lemon stock, but always obtained sweet oranges. This result is confirmed by all the gardeners of Finale (a small town in the north of Italy) for more than sixty years. There is no example of a sour orange produced from a sweet seed, nor of a sweet orange produced from a sour seed.

From these experiments are obtained the following conclusions:

Consequence I.—The seed perpetuates the species and is the source of varieties. It produces more frequently varieties inferior to the mother plant; sometimes, however, those superior to it. It never departs from the species unless the fecundation of another species gives it the germ of a hybrid. (Exp. I and III.) This occurs equally in the seed of the seedling and that of the grafted tree. The trees which come from them reproduce the same species which gave the seed, aside from the modification of varieties noticed above. (Exp. IV.)

Consequence II.—The seeds of monsters, when they are found, produce only ordinary fruit, which indicates that this extraordinary fruit is only a variety, and that the variety returns to the type in the seed. (Exp. II.)

Consequence III.—The seeds of the sweet orange produce only sweet orange trees; sour orange seeds produce only sour orange trees. These two orange trees are preserved and perpetuated by the seed, and are, therefore, distinct species. The ordinary peach never produces the cling-stone, nor the cling-stone the ordinary peach, and hence they are two distinct species, and can not degenerate from the one to the other. The same is true of the sweet and bitter almond. (Exp. I and IV.)

Consequence IV.—The seeds of lemons growing in a garden where lemon and citron trees grew together, produced poncires. This fruit is, therefore, probably a hybrid of the citron, the absence of seeds showing that it is due to a foreign fecundation. (Exp. III.)

ART. VI.—*The theory of vegetable reproduction.*

My experiences as a whole sufficiently substantiated the most of the phenomena presented by the multiplication from seed. They determined the origin of varieties in plants. But it remained still to know the secret causes of these results—why nature departed in some cases from the system generally followed in reproduction.

Every seed in nature is only the germ which is to renew the individual which produced it; but some vegetables we have seen depart from this system.

What is the cause of these exceptions? I observed that these phenomena took place from preference in the seeds taken from plantations where there was a mixture of species or varieties; that lemons gathered in the garden where there were citrons gave more varieties than those from trees standing alone; that the seed of the black cabbage which had flowered in the midst of many cabbages of different varieties, produced frequently cabbage remarkably well headed, much sought for its delicacy and whiteness; that the seed of the crowfoot of several colors, which I cultivated in quantity in plots of my garden, gave very often double flowers, while this did not happen with the seeds of the same flowers which I had cultivated in vases, each by itself, before the establishment of my flower garden.

All these observations presented a certain analogy between the hybrids and the monsters, and I suspected that the influence of the pollen which effected the mixture in hybrids might also cause

sterility, and those modifications of leaf known as curled or streaked.

A crowd of reflections were presented to my mind. It is recognized, I reasoned, that two different principles must co-operate for the reproduction of all organized beings. We know that when these principles belong to different species monstrosities result, such as mules among animals, and among vegetables the mixed plants known under the name of hybrids.

Why may not this principle, which effects so many phenomena, be the cause of monsters and varieties? These, it is true, do not prove the mixture, for they are produced even from the seed of isolated trees; but is it necessary that the principles of two different species unite in fecundation in order to change the physiognomy of the product? Cannot this be as well accomplished by different properties of the two agents in the same species, and perhaps also by a difference in the force of their action, or by a defect in the analogy in their principles? Is it not from the different proportion of these two agents of organic reproduction, that results this marvelous variety, distinguishing all animals by a peculiar physiognomy? There is no fruit in the same plant even which is exactly like any other.

Might not the inequality which exists among the fruits of a single tree, as we observe it among the children of the same father, exist still more pronounced between the fruits of two different plants, although of the same species? Should not the pollen of the flower of one peach tree have a family likeness which would make it different from that of the flower of another peach tree, and if these two peach trees, modified in their conception by fecundation, were already marked by those differences which constitute varieties, would not the reunion of their flowers produce a new combination which would constitute a variety still more irregular? Finally, what might not the difference in the proportions and the mixture of several pollens produce? Would not a forced fecundation act upon the ovary in an extraordinary manner, and changing the natural relations of the principles, form heterogeneous combinations incapable of bearing sexual organs?

All these queries were presented to my mind in a manner so favorable and seductive that I made no delay in preparing experiments to throw light upon them. Their results have been so satisfactory that I have been able to draw therefrom a theory which has served as the basis of my classification of orange trees. I shall give an explanation of them.

ART. VII.—*Experiments in artificial fecundation.*

Experiment V.—I chose a number of plants of the Asiatic, ranunculus, of simple flower, and of different colors. I put each one in a vase, and placed them in as many different windows, separated from each other. I fecundated the flowers of one-half these plants with the pollen of each other, but left the other half undisturbed. The following results were obtained: The seeds of the flowers fecundated as aforesaid produced roots of which some gave double flowers, others semi-double, and the greater part only single flowers. The plants not fecundated gave only

plants with single flowers. This experiment was continued in the following manner: I chose plants of semi-double flowers, and fecundated them with the pollen of other semi-double flowers. Several others of semi-double flowers were left untouched. The seeds from the fecundated flowers produced roots bearing for the most part double flowers, crowned often in the middle by a tuft of green leaves which rendered them very pretty. The seed from the flowers not fecundated, although already semi-double, gave only plants bearing single flowers. I repeated this experiment for several years, but always with the same result, and a similar experience with other flowers gave also the same.

Experiment VI.—I fecundated the flowers of the orange with the pollen of the lemon tree, and I obtained a fruit whose skin was cut from end to end by a stripe yellow and elevated, having the characteristics of the lemon. The taste of the fruit was entirely that of the orange. It had few seeds, and these small and poor.

Experiment VII.—I fecundated the flowers of an orange tree with the pollen from several other orange trees, and obtained several times fruit whose pericarp had an irregular form, containing few seeds and those very defective.

Experiment VIII.—I sowed orange seeds whose flowers had been fecundated, and whose pericarp had suffered no change; and obtained plants which do not yet bear fruit, but one of them is devoid of spines, and another displays a very vigorous foliage, which distinguishes it from ordinary orange trees.

METHOD PURSUED IN ARTIFICIAL FECUNDATION.

The procedure which was employed in the artificial fecundation is simple, and indicated by nature herself.

I chose the ripest and most highly colored pollen from the most thrifty flowers, and those most nearly ready to bloom, and applied it to the pistil of the flower which I wished to fecundate. In order to render the operation more exact, I detached the flower from its stem, and having despoiled it of corolla, I rubbed the anthers without touching them, upon the stigma to be fructified. This operation was repeated with several different flowers, without depriving the flower submitted to the operation of its stamens. I took care to repeat it several times each day for several days. This precaution was necessary in order not to miss the moment of blooming in the pistil which was to receive the pollen, and to assure myself by means of a quantity of this pollen taken from different flowers, respecting its disposition to exercise its fecundating qualities.

In the flowers of the orange tree the moment of maturity for fecundation seems to be announced by the appearance of a honey-like drop which forms on the stigma of the pistil, and serves to retain the dust applied to it; and the same maturity in the pollen is indicated by the deep yellow color it then assumes, and by its quality of adhering to the finger when touched; but it is also necessary to be careful to multiply the experiments, because often after having fecundated several flowers as one may suppose, none, or but few, may be successfully operated upon. But success is more certain with the ranunculus and carnation.

CONSEQUENCES.

Consequence I.—Mixed fecundation operates in various ways upon vegetables. It may act upon the ovaries or upon the ovules. (Exp. V., VI., VII., and VIII.) When it acts upon the ovaries the pericarp of the fruit which has been fecundated receives modifications, and bears but few if any seeds. (Exp. VI. and VII.) When the action is upon the ovules the fruit which encloses them does not seem affected by it, but these ovules grown into seeds give some trees which do not resemble the parent tree, and most frequently have a tendency to sterility.

This tendency to sterility determines itself in different ways; sometimes upon the flower, when we have plants with double, or semi-double, or possibly with simple and sterile flowers; sometimes upon the fruit, when we have plants with sterile or semi-sterile fruit, for these fruits either bear no seeds, or very few, and those badly nourished. In all cases these species of mules or hybrids show unusual vigor in the thrifty branches free from spines, or in the better nourished leaf, or the flower with multiplied petals, or the fruit of more beautiful pericarp. These characteristics especially distinguish the greater part of the beautiful varieties; hence the varieties are due only to an extraordinary fecundation which acts upon the seeds and modifies them at the moment of their conception.

ART. VIII.—Phenomena observed in hybrid plants.

Observation I.—There is a species of Citrus known in Italy by the name of bizzaria, and in France by that of the hermaphrodite orange (*aurantium limo citratum, folio et fructo mixto*), and which bears at the same time sour oranges, lemons, citrons, and mixed fruits.

I have observed upon this hybrid that the same branch bears at the same time leaves and flowers, of which some announce the sour orange tree, others the lemon, and still others the citron tree. They produce fruit which belong sometimes to one of these species, at other times to two or even three of them mixed.

A scion which springs up violet often develops a branch, some of whose flowers are violet, others white, and the buds of this branch grafted upon another stock sometimes produce there the caprices of the variety, and sometimes perpetuate a simple sour orange, although they may have been taken from the axil of a citron leaf; and reciprocally a simple citron, though taken from the axil of a sour orange leaf.

This caprice has forced the gardeners to multiply it by the layer. It is thus that this hybrid is perpetuated without degenerating.

Observation II.—I fecundated white pinks with red pinks reciprocally. The seeds thus produced gave pinks of mixed flower. Several of these plants presented the following phenomena: The same plant which gave mixed flowers gave some flowers entirely white, and others entirely red. One year it gave only red flowers, and the next mixed flowers again. Others, after having produced mixed flowers two or three years, subsequently produced only red ones; they seemed entirely to have returned to the species.

Observation III.—Similar to the bizarrerie is the violet sour orange, which is cultivated at Paris, (*citrus aurantium indicum fructu violaceo*). I have noticed in the specimen growing in the Jardin des Plantes that of the flowers springing from the same branch—some were white, like those of the orange tree, and others violet, like those of the lemon tree—a variation appearing equally in the fruit. Others have observed in individuals of this race that this caprice may appear one year, be wanting the second, and reappear the third year.

Observation IV.—With the pinks, of which I spoke above, may be compared the streaked orange trees (*citrus aurantium folio et fructu variegato*). I have seen some of them which developed branches in no way affected by that yellowish border which marks the foliage of these trees; and I have seen this caprice reappear in others after it had been almost lost for years.

Observation V.—The gardeners of Liguria have a practice of separating from other cabbages the cauliflower, destined for seed, by transporting them into isolated gardens, and surrounding them by a sort of enclosure of branches or straw in order to preserve them from the influence of the other species.

Owing to this precaution vegetable gardens present only plants of the ordinary form.

I have seen plots of cauliflowers (*brassica oleracea botrytis*) and of brocolis (*brassica vulgaris sativa*), whose seeds had been gathered from plants of these two species, which had been sown pell-mell in the same bed, and almost every head had curled and streaked leaves.

CONSEQUENCES.

The pollen of one species acting upon the ovary of another, produces a modification in the seed which results from it. This modification is sometimes uniform and constant, and sometimes variable and inconstant.

It offers most frequently the example of a mixture in the substance of the germ, which is identified with it and affects all its parts without undergoing afterward any change.

It offers sometimes the example of a principle which circulates in the essence of the vegetable and sometimes affects its products, and which sometimes, without affecting them externally, passes, nevertheless, into their essences, to reappear in succeeding products, as well as sometimes abandoning one part of the vegetable to concentrate itself in another. These caprices appear in hybrids but not in varieties. In these last the principles which are blended have among them considerable analogy, while those united in the hybrid are by nature heterogeneous.

The hermaphrodite orange is due to the seed. This is an ascertained fact, established in a dissertation by a Florentine naturalist, published in 1644.

It is owing to fecundation; it is a fact which results from its forms, from the nature of its productions, and from all the phenomena of its existence.

The pink of mixed flowers, giving red and white flowers, is due to the seed, and to a seed proceeding from a fecundated flower; it is a physical fact, since it results from an operation made with the greatest exactness.

The phenomena of these two hybrids have a

great analogy with the phenomena of the streaked plants.

We remark in these hybrids this same inconstancy in the accidents which gave rise to the belief that the streak is only a disease. If the heterogeneous mixture in fecundation is the cause of the mixture which affects the fruit of the bizarrerie and of the colors which appear and disappear in the pink, it may be equally the cause of the streak. The streak offers no other circumstance which it might be difficult to reconcile with these principles except the inconstancy of its phenomena. The example of the orange and the pink prove that it is not incompatible with this cause. If this streak be a disease, it originates in the germ and affects the substance of it in the fructifying principle, and in this case can be due only to fecundation. But this phenomenon of streaks seems to be rather a monstrosity than a malady, since it has uniform and regular forms which affect all the leaves alike. If it were a malady, the individuals affected by it would not possess the vigor and health which usually characterize them. It would not be produced by preference from seeds gathered from plants mixed with other varieties, and a whole plot would not be affected by it, as happens in the cauliflower, but they would appear isolated among healthy individuals, and might be produced by any seed whatever.

ART. IX.—Theories respecting vegetable reproduction—Corollaries—Conclusion.

These experiments, facts, and analogies, taken as a whole, necessarily give rise to principles which form so many theories in the system of vegetable reproduction.

1. Nature has created the genera which form so many families distinguished from each other by peculiar marks.

2. Nature has created the species also which form so many branches in these families to which they belong on account of common characteristics.

3. The mixture of these species in the union of the sexes has given rise to hybrids.

4. The mixture and proportion of the productive principles of several individuals of the same species have produced the varieties.

5. The irregular and forced action of one principle upon the other in the act of fecundation, either in the same or in different species, has given rise to monstrosities.

6. The varieties are, therefore, due only to the seed.

7. The seed originates equally the varieties called choice and those growing wild.

8. Cultivation has destined the first to furnish the graft and the second to bear it.

9. The graft and the slip only can perpetuate these varieties in their natural condition.

10. The seeds of these varieties are also submitted to the influence of fecundation and subject to give new varieties by it, sometimes better, sometimes inferior, in quality. It gives types when the fecundation takes place according to the laws of nature.

11. Monstrosities are individuals whose organization has undergone an alteration by the fact of fecundation.

12. If this alteration occurs in the ovary the

monstrosity is in the fruit which results from it and perishes with it. If this alteration be in the ovules, the monstrosity is in the germ, and this germ sown produces a variety which bears only monsters.

13. Every monstrosity regularly is sterile, either from the nature of the flowers which are without sex, or whose sexual parts become petals, or by the nature of the fruit which has no seeds. It must be multiplied by the graft or slip.

Corollary I.—The species form many branches in the families known as genera and to which they belong by common ties or characteristics; these are distinguished from each other by peculiar marks or features.

These features or characteristics are constant, and distinguish the type from the varieties. The types are always fruitful. They are reproduced by their seeds unless these seeds are modified by fecundation. They are also reproduced by the seeds of the varieties.

Thus the seed-beds offer the surest means of distinguishing the species from the varieties.

Every tree which is perpetuated by descent and preserves its forms, characteristics, and properties is a type. It can undergo no changes except by fecundation; but those changes which are made in the germ do not extend to the reproductive principle. The sexes disappear in these individuals, or pass intact through the modifications of the flowers and the ovary. They bear in them the principles of the type. Among peaches I have verified three types, the peach, the cling-stone, and the nectarine peach. Among cherries I have verified two, the white-heart cherry, and the round or black cherry. I have data which leads me to suspect that there is a third type.

I have not yet determined the types of the apricot, the apple, or the pear. My experiences are not yet sufficiently advanced respecting these species. I have, however, determined to a certainty that the *Citrus* has but four species.

Corollary II.—The blending of species in the reunion of the sexes has given rise to hybrids.

The hybrid partakes of the characteristics of the two species of which it is composed. Thus its exterior physiognomy reveals its origin. It has a tendency to sterility. The hybrid presents phenomena which are very singular. The mixture sometimes affects the substance of the vegetable, and we have then a mixed fruit whose forms are constant, but which is generally unfruitful. Such are the poncire, the double mixed pink, and the double flowered ranunculus. At other times the mixture seems to be, as it were, wandering in the vegetable, and then it affects isolated parts of the plant capriciously, and disappears sometimes, to reappear in the products even of those parts which did not seem before to be affected. Such are the *orange de bizarrerie*, the violet orange, and the variable-flowered pink. In these cases the fruits affected are sterile, or semi-sterile, and the fruits not affected produce seeds.

Corollary III.—*Varieties.*—The mixture and proportion of the reproductive principles of several individuals of the same species have given rise to varieties. Varieties are only aberrations or departures from the type. They are of two sorts: Varieties from excess, and varieties from

deficiency. Varieties from excess are due to a superabundance of the masculine part, and still more to the mixture of the pollen of several flowers. Varieties from deficiency are due to the lack of proportion between the sexes, or the weakness of the masculine part. They are also sometimes due to a defective organization of the ovary. Varieties from excess most frequently tend to sterility. They are marked by a striking thrift and a lack of thorns. Their seeds, when they have any, reproduce the type, unless a foreign fecundation has acted upon the flower and formed a new combination.

Thus, every sterile or semi-sterile fruit is only a variety. Its seed, in the state of nature, will return to the species. It is, therefore, by means of the seed-bed that we are enabled to recognize the species to which varieties belong. Stoutness and the loss of thorns always accompany the absence of seeds. It is, therefore, at the expense of the generative parts that vegetables acquire marked development in the leaf, bud, or fruit. Nature seems to have assimilated them to animals which acquire volume and lose the hair when they are barren. Varieties from deficiency deviate from the type for reasons directly opposite to those which cause deviation in varieties from excess. The imperfection of the fecundation affects the germs which bear in their principles a defect of organization. These germs produce only wild plants, as we call them, which are degenerated individuals, whose products are badly organized, and whose seeds are poorly nourished. These seeds, which often perish, still ordinarily generate feeble and languishing plants, but sometimes they give types.

It is to the accidental vigor of a branch bearing well-formed flowers that we owe this return to the species. Thus, varieties by deficiency are due often to climate and culture, but these influences act only indirectly. They facilitate or retard the development of individuals, and, consequently, the perfection of the reproductive principles; but every change is operated in the germ and only as the effect of fecundation.

Every variety is a monster to nature, and some varieties are so regarded by men, such as the varieties from deficiency. But varieties from excess ordinarily form the delight of the table and the ornament of the garden. Nature aims at only the production of seed, and when fruit bears many seeds, it is perfect in the system of Nature.

Man seeks only pleasure in Nature, and hence judges differently of vegetable productions, on account of the advantage to be derived from their use. He, therefore, prefers, in certain fruits, those varieties whose pericarp is more developed, tender, and juicy. He is thus opposed to Nature, as in the case of the apple, pear, and peach. In other fruits he prizes the cotyledons or seeds, and regards the pericarp as useless, the more so in proportion to its development; and in this he approaches the plan of Nature, as in the almond, chestnut, the bean, and the pea.

Others still are prized for a portion of the pericarp, and a variety is considered choice only when this part is developed at the expense of the pulp, as in the melon and citron. Other fruits are valued for the pulp only, as the lemon and orange. There are also vegetables in which the flower alone is esteemed, and then that va-

riety has the preference in which this part is developed at the expense of the generative parts, as in double and sterile flowers.

Others are sought only for their aroma, as the sour orange. Finally, capricious man attaches value to monsters even, which are useless to him, and seeks for ornament odd and rare forms, such as shriveled leaves, leaves developing out of proportion the yellow streak which borders the leaf, a tendency of the branches to descend to the soil, and other monstrosities of this nature. All these caprices form the ornament of our gardens and the delight of our tables; but to Nature they are departures from the object she has proposed to herself. She repels them and condemns them to perish. But man has succeeded in preserving and multiplying them. The seed refusing to give germs capable of reproducing them, he has propagated the individual he possesses by dividing it into a thousand parts, and thus by grafts and scions preserves it without change. Thus these adulterous sons have filled our gardens, and the types have been banished to the woods.

MONSTERS.

According to the fifth theory monsters are only individuals whose organization has undergone alteration by fecundation. If this alteration take place in the ovules the monster is in the germ, and this germ sown, produces a variety bearing only monsters. We have already analyzed this phenomenon. If this alteration take place in the ovary, the monster is in the fruit which results from it and perishes with it. This phenomenon is so extraordinary that I hesitated a long time to believe it, but the experiments which I made respecting it have convinced me of the truth of its existence.

It presents three kinds of facts. The first is the alteration of the forms of the ovary. This part acquires a partial and irregular growth, which develops the pericarp on one side, and impresses upon it very singular forms, such as linear, depressed or curved prolongations, which often contain in their interior a pulpy principle or a unilocular pulp. This phenomenon often appears in the orange and lemon. I have sometimes seen it in peaches.

The second fact is the change of nature in a part of the ovary or of the pericarp resulting from it. This exterior body sometimes bears a binding or stripe of the species with which it has been fecundated, as the orange, whose flower has been fecundated by the pollen of the lemon. It is difficult to harmonize such phenomena with principles well understood; but a fact is a fact, and Nature is sometimes as impenetrable as marvellous in her operations.

The third fact is: One flower fecundated by a quantity of dust from several other flowers offers the phenomenon of a fruit containing in itself a second fruit of the same nature. This phenomenon is frequent in oranges. Rumphius says that at Amboine there are species which present many such instances, but cease to give them if transplanted to Banda. This has always been attributed to fecundation, and my experience goes to confirm this opinion. The fruit which presents this appearance is often ruffled, or in a manner folded inwards; at other times the ruffling resembles a second fruit which proceeds from the interior of the first, but always ruffled in form. If

we cut these fruits we perceive a mixture of peel and cells, the one in the other, which creates confusion and announces superfetation.

These monsters rarely bear seeds. They frequently occur in certain species, are rare in others, and never appear in the larger part of our indigenous vegetables.

These differences are due, perhaps, to the different dispositions of the sexual organs and their relative conformation. They are, perhaps, due to difference in climate, which may favor or injure them at the time of flowering, and to other circumstances which Nature conceals from the eyes and researches of man.

CHAPTER II.

THE GENUS CITRUS ARRANGED ACCORDING TO THE NEW THEORY OF VEGETABLE REPRODUCTION.

ART. I.—*The Citrus—Divisions of Botanists and Agriculturists—Divisions adopted in this work—Primitive species—The species of the Indies.*

The Citrus is a genus whose species are greatly disposed to blend together, and whose flower shows great facility for receiving extraordinary fecundation; it hence offers an infinite number of different races which ornament our gardens, and whose vague and indefinite names fill the catalogues.

It is the multitude of these beings which we propose to describe. We shall endeavor to classify them according to the principles already explained. We shall describe species, hybrids, and varieties, and endeavor to establish their identity. This is, perhaps, one of the most difficult portions of our work, first, because the botanists or agriculturists who have described the varieties have not always done so with the exactness requisite to enable us to recognize them among so many different names; and, secondly, because in the course of centuries several of these varieties have disappeared, from frosts or other influences, and been replaced by a quantity of new varieties which resemble them, and which, by means of some slight differences, create confusion in the application and comparison of these descriptions.

It is only with the aid of knowledge which I have acquired of these varieties in our gardens, where I have cultivated them for a long time passionately, and in those of several semi-tropical countries which I have visited for this purpose, that I venture to undertake the task of reconciling this numerous and perplexing nomenclature.

I will begin by examining the species.

Some authors have regarded the citron alone as the original species and the type of the other species.

Tournefort, with most botanists of the sixteenth and seventeenth centuries, has recognized in the lemon and sour orange the characteristics of types as well as in the citron, and has considered the sweet orange as a variety of the sour orange.

The Arab agriculturists have ranked Adam's apple (*la pomme d'Adam*) among the species, which they have designated by the name of *lay-*

samou or *zambau*; and being acquainted with the sweet orange only, they divided the genus into the citron, lemon, sour orange, and zambau.

The Italian and French agriculturists have added to these four species the sweet orange and a multitude of varieties known by the names of limes, lumies, poncires, &c.

Linnaeus, attached to the artificial system which he had just established, placed the *Citrus* among the polyadelphias, referring to the union of the stamens in several bundles; and he ranged it in the order of *icosandrias*, referring to the number of organs which he supposed, in all the species, to be twenty, although we find in the lemon and citron as many as thirty or forty.

He also fixes the accidents which determine the form of the petiole of the leaf, and not having remarked that the petiole of the citron tree is not articulated like that of the lemon, he has made of these two races a single species, distinguished by the characteristics of linear petioles (*petiolis linearibus*.)

The winged form of the petiole has been the characteristic which has determined his second species, and as this accident distinguishes equally the sweet and sour orange, Linnaeus has regarded the latter as the type and the former as a variety, and united them under the name of *Citrus petiolis alatis*, or *Citrus*, with winged petioles. Finally, he has made a third species of a Japan orange, described by Kämpfer, referring to the ternate leaves, and called it *Citrus trifoliata*.

The later editors of Linnaeus augmented the number of these species by one called *Citrus decumana*, which Linnaeus himself ranked among the varieties. They thought that its obtuse and scolloped leaf (*foliis obtusis emarginatis*) was a sufficient characteristic to constitute it a type, and did not observe that this peculiarity is neither general nor constant, and that in consequence it is rather a monster than a characteristic feature. They have also added the *Citrus angulata* or *limonellus angulosus* of Rhumphius, and the *Citrus japonica* of Thunberg, whose characteristics are, without doubt, too different from those of our specimens of the *Citrus* family not to constitute distinct species.

We have followed a new method; we have begun by seeking the species among all European specimens of the *Citrus*, and arranged around these their hybrids and varieties.

We have also presented some reflections upon the species of the Indies, of which we have given only an idea, leaving to more enlightened botanists the task of examining and classifying them, as we have those of Europe.

The seed-beds have been the principal means made use of in our search for species.

We have seen the citron tree of the Jews (*Citrus medica cedra fructu oblongo crasso eduli odoratissimo*, GALL. SYN.) reproduced constantly from the seed. It has many seeds, the greater part of which always give citron trees having constantly the same characteristics in aspect, form, and properties; it is, therefore, a type.

All other citrons are sterile or nearly so, and hence are only hybrids or varieties. Such are the Chinese citron, (*Citrus medica cedra fructu maximo aurantiato*, GALL. SYN.) the cedrat of Florence, (*Citrus medica cedra Florentina fructu*

parvo, GALL. SYN.) and several others which resemble them.

The common lemon (*Citrus medica limon fructu ovato*, G. S.), also contains many seeds. It is reproduced constantly from the seed, and its peculiarities are perpetuated in its descendants. It is, therefore, a species. It produces hybrids and varieties, but they are found rarely, and only among many types. They have few seeds, and these reproduce most frequently the type. Sometimes they contain no seeds, and it is always in those deviating most from the type that we remark this sterility. The poncire or cedrat lemon (*Citrus medica limon fructu citrato*, GALL. SYN.) is of this number.

The sour orange also produces many seeds, which always reproduce sour orange trees. Hybrids are met with only among a great number of types. Varieties are found more frequently, but these deviate very little from the characteristics of the type, and their seeds always reproduce it; hence the sour orange is a species.

The sweet orange has many seeds, which always reproduce sweet oranges. They give rise to varieties, and we often remark in the same sowing, orange trees of ordinary fruit and others of superior fruit, but there is no single example in which these seeds have produced a sour orange tree. The sweet orange is, therefore, a species.

When it gives monsters they have no seeds, or very few; such are the seedless orange (*aurantium semine carens*, FER.) the red orange (*aurantium hierochauticum*, GALL. SYN.) and the small China orange (*Citrus aurantium caule et fructu, pumilo*, GALL. SYN.)

These four species are, therefore, certainly types. They do not, perhaps, present all the exterior characteristics which the botanists have adopted to distinguish species; but in the study of natural history it is necessary to guard against forcing nature in order to make her conform to various systems.

She is not confined to constant forms and determinate modification in order to distinguish vegetables. She is pleased to vary those distinctive signs by which she has marked these divisions. She has, from preference, fixed them in the fructifying parts and the form of the leaf, but has not, on this account, renounced less general peculiarities. It is sufficient that a characteristic be constant, or unalterable, or pronounced, in order to be distinctive for nature. Thus the acidity and bitterness of the pulp of the sour orange, the aroma of its peel, its leaf and flower, being qualities constantly attached to this plant, altered neither by culture nor climate, nor even by the seed, may and must be distinctive characteristics of this species.

These are the principles which have guided us in the classification of the species of the *Citrus* of Europe. We have been able to recognize only four of them; all the others are only hybrids or varieties. They all present the mixture of these four mother-species, and their characteristics, confounded and combined in a hundred different ways, never depart from the model of these four types.

Such is evidently the nature of all the races seen in the gardens of Europe. It is only in the Indies that we meet with a great number of others whose physiognomy assimilates them to our

species, without, however, manifesting exactly their peculiar features. Such are most of the races of Amboine, of which Rumphius has given us the description; such are some races of the Cochin China and China fruit, described by Loureiro; and such, finally, are some races from Japan, reported by Kämpfer and Thunberg.

The most of these races not only cannot be regarded as varieties of our Citrus family in Europe, but they cannot even be considered as species belonging to our genus Citrus. They differ sensibly from them, considered either with reference to the conventional features established by artificial systems, or the natural features presented by the structure of their trunk, the form of their leaves, the character of their flowers, the properties and modifications of their fruits. Their physiognomy, as a whole, announces that they belong to the same natural family as the Citrus, but that they form another branch or genus of it which has its own species, varieties, and monsters.

Perhaps among those which have more relation to the Citrus, there may be some which unite these two analogous genera and form a transition by which nature passes from one genus to the other; perhaps also this transition is apparent in some other species deviating more from them, and approaching more to the *cratæva marmelos*, the *murraya exotica*, and the *limonia*.

We will leave to botanists the examination of this conjecture, which demands profound scientific knowledge, experimental observation of those plants which we at present are acquainted with only from descriptions, and which no one probably has as yet studied in all the details of their vegetable life. We shall confine ourselves to a general view of the species arranged by botanists under the genus Citrus, and the varieties which belong to them.

ART. II.—Order of divisions followed by Nature—
First division—Second division—Characteristic features which determine them.

These principles fixed, it is easy to classify in a natural order the Citrus family of Europe. Nature, which never proceeds by leaps, but always gradually and insensibly in her operations, has commenced by dividing this genus into two sections, of which one is formed by the citron and the other by the orange. She has marked these two species by several pronounced and constant characteristics, which form their physiognomy.

The citron tree has always a leaf with a linear petiole, a scion or young shoot of a violet red, flowers partly hermaphrodite and partly dioecious, the corolla white within and shaded with violet red without, stamens to the number of thirty or forty, the fruit oblong, yellowish, with a tender peel, adhering to the pulp.

The orange tree, on the contrary, has constantly a leaf with a winged petiole, the scion of a whitish green, the flower hermaphrodite, with an entirely white corolla, and stamens to the number of twenty, the fruit round, golden, and having a peel interiorly cottony or downy, and not at all adherent to the pulp.

But this first division was not sufficiently adapted to the infinite combinations with which Nature wished to enrich this beautiful genus. She has,

therefore, subdivided these two species into as many sub-species, which have also received their character from the hand of Nature, and are, consequently, equally invariable.

The citron has been divided into the cedrat and the lemon. The orange has been divided into the orange and bigarade.

The cedrat tree has been distinguished by short and stiff branches, green and oblong leaves, whose petiole is smooth and continuous with the central vein which divides them, and by its oblong fruit, formed of a thick, tender, and aromatic peel.

The lemon tree, on the contrary, bears long, pliant, and flexible branches, with large and yellowish leaves, whose petiole is raised on the sides by a kind of jutting out, and articulated at the point of its union with the disk of the leaf; it bears fruit with a smooth, thin, and bitter peel, and an abundant pulp, full of an acid but agreeable and piquant (sharp) juice.

The sweet orange differs from the bigarade by its appearance or bearing, which is more vigorous, by its flower, which has less aroma, and by its fruit, whose peel, which is thin, contains a more feeble essential oil, and whose pulp is full of a sweet and agreeable juice. A less majestic bearing, an infinitely more odoriferous flower, and a fruit whose peel possesses a bitter and piquant aroma, mingled also with the acidity of the pulp, are the distinctive characteristics of the bigarade tree.

These four species have been the elements for forming all the races we now possess. They have been subdivided into various generations, which have been modified by fecundation without altering the characteristics of the species, and have given rise to varieties. They have been subsequently crossed among themselves in a great number of different proportions, and have given birth to hybrids which are as numerous as the gradations or variations of which these combinations are susceptible. Nevertheless, all these different races always, by their peculiarities, announce either one or several of these types, and we find everywhere either their isolated mark or the mark of the reunion of several of them.

We will commence by giving a representation of the species.

THE CITRON TREE.

The citron tree is an arboreous plant. It does not bend like the lemon tree. It does not grow high like the orange tree. Its branches are short and stiff. Its leaves are violet at first, but afterwards green, alternate, simple, oblong, dentate, and sprinkled with an infinite number of little points, which are so many vesicles containing the aroma. The petioles are nude, and only a continuation of the central vein of the leaf. The bud is large, conical, and guarded by a solitary spine. It puts forth, during almost the whole year, flowers in bouquets or clusters, each borne on a pedicel resting on a peduncle, sometimes axillary, but regularly terminal and multiflorous. The flowers, in part hermaphrodite and partly dioecious, are formed of a monocephalous five-pointed calyx, which contains a corolla whose petals, five in number, are enlarged at the base, inserted around a hypogynous disk, white within, and shaded without with a violet red; the stamens, thirty or

forty in number, have the same insertion as the corolla; the filaments are brought together in cylindrical form, crowded at the base and polyadelphous; the anther is yellow, linear, and divided in the middle by a hollow; the pistil is composed of a simple ovary, ovoid, surmounted by a single, fleshy style, and a simple globular stigma, the pistil covered with a viscous substance like honey. The fruit is capsular and multilocular. It is formed of two skins, of which the outside one is rough, yellowish, thin, sown with an infinite number of globular vesicles appearing like little points, and full of a very aromatic oil; the interior skin is thick, white, tender, fleshy, and forms the most considerable part of the fruit. Under this interior skin is a membrane which envelops the pulpy part, and which, penetrating the interior, forms double partitions converging to an axis, where they divide the fruit into nine or ten sections. These sections are polyspermous. They are filled with a pulpy flesh formed from a quantity of oblong vesicles full of an acid juice, and containing cartilaginous seeds in indeterminate number.

THE LEMON TREE.

The lemon is a tree, but its pliant branches show a preference for an espalier.

Its leaves are ovoid, large, dentate, of a clear green, tending to yellow. They are borne on a petiole, articulated at the point of its union with the disc of the leaf, and guarded by two projections on the sides. Its shoots while tender are of a purplish tint. Its flowers are larger than those of the orange, and a little smaller than those of the citron tree, and partly hermaphrodite and partly dioecious. The corolla has five petals, colored red without and white within, set upon a green five-cleft calyx, in the midst of which in the hermaphrodite flowers rises a pistil smaller than in the citron, surmounted by a stigma covered also with a viscous humor and surrounded by from thirty to forty stamens united into several bodies and bearing a yellow anther. The fruit, almost ovoid, is nipped, or pointed, at the summit. The exterior skin is thin and of a very pale, clear yellow tint. The interior skin is thin also, white and tough. The first is formed of a quantity of little vesicles containing a very penetrating aroma, which vanishes in a great degree when the fruit reaches excessive maturity. The pulp is enclosed in nine or eleven sections, which form the most considerable part of the fruit, and are composed of an infinite number of oblong vesicles of a light yellow, containing a sharply acid juice, abundant and very agreeable. The parenchyma or pellicle which covers these sections is so adherent to the skin or peel that it can not be separated without being torn. It is thin, transparent, and without bitterness.

THE ORANGE TREE.

The orange is more vigorous than the citron and lemon trees. It forms a full and majestic tree. Its leaves are oblong, pointed, slightly dentate, and winged in the petiole, and of a very deep green, which distinguishes them at once even to the sight from those of the lemon and citron trees.

The constantly hermaphrodite flower has five petals, and is distinguished from those of the citron and lemon by its whiteness and the grate-

ful odor emanating from it. The stamens, twenty in number, are divided into several bodies, and bear an oblong anther, whose pollen is of a deep yellow.

The fruit of the orange tree is spherical, and sometimes flattened. Its peel is more or less thin, according to the kinds; its interior part is light, stringy, and tasteless; its exterior is thin, colored a golden yellow, which distinguishes the orange from the lemon and citron, and is composed of a quantity of vesicles containing an agreeable essential oil.

The sections, nine in number, which form the larger part of the fruit, are enveloped in a transparent membrane, which is with much facility detached from the peel, to which it clings only by the white, cottony substance forming the interior skin. The pulp contained by these sections is formed of a quantity of oblong vesicles of deep yellow color, full of a sweet and refreshing juice, and contains oblong, cartilaginous, and yellowish seeds.

THE BIGARADE TREE.

The orange tree having sour fruit, or the bigarade, does not grow so high as the sweet orange; its leaf has the heart of the petiole more pronounced; its flower has vastly more aroma, and is preferred for perfuming waters and essences; its fruit is somewhat rough and of a deeper reddish tint, and the vesicles contained in the exterior skin have a stronger aroma, indicating also the bitterness of the interior peel and the parenchyma which covers the sections of the fruit. Its juice is sharp, and also slightly bitter from the membrane forming the vesicles in which the juice is contained.

THE CITRON FRUIT.

The citron is eaten only as a comfit. The quantity of juice in its pulp is so small that little account is made of it; it has the properties of lemon juice, but is less acid and has less perfume. The peel of the citron is the part most used; the essential oil which it contains in the exterior part is in a liquid state in the prominent vesicles, which give to it the tuberosities which characterize it. This oil is often pressed out, and, mixed with sugar, is soluble in water, and used for giving an aromatic flavor to liquors. The interior part of the peel, or the white, is agreeable to the taste when its aroma is corrected by sugar; it is especially delicious when preserved, and in this form it is generally found in commerce.

THE LEMON.

The lemon peel contains also an essential oil full of aroma; but this fruit is used only for its acid and agreeable juice, which is very abundant, and serves for seasoning animal and vegetable substances. From it is also made, with sugar and water, a drink beneficial to persons suffering from inflammatory and putrid fevers. It is the principal specific in scurvy, and the best antidote against vegetable poisons.

The lemon contains citric acid in a perfect state, only mixed with water, from which it can be easily separated. It furnishes to the art of dyeing a means of enlivening red colors taken from the vegetable kingdom, and especially the color of the carthamus or safflower, which by this means becomes so brilliant in silks. It has a similar use in China and India, where the juice is also used in order to prepare metals for gild-

ing, in the same manner as Europeans employ aqua fortis.

THE ORANGE.

The sweet orange is one of the most delicious and refreshing of fruits. It is antiscorbutic and very useful in bilious maladies. Its peel has an essential oil full of aroma, which at maturity loses its biting and bitter quality; the peel may then be eaten. In the finest varieties the peel is very thin. It is thicker in others, but the white part, instead of being fleshy as in the citron, is always cottony, light, and tasteless. Orange juice is extremely sweet and agreeable. The sweet orange is eaten in its natural state, and this is almost its only use.

THE BIGARADE.

The bitter orange is not eaten. Preserves are made from them, which are very agreeable. The peel is more aromatic than that of other species, and the essential oil it contains has always a bitterness and caustic taste which distinguishes it from the sweet orange. The juice of the bigarade is sharp and bitter. It is used in the same manner as that of the lemon, as an agreeable seasoning for animal and vegetable substances, and especially for fish, whose tendency to putrefaction is thus greatly diminished. But the principal of the bigarade tree is that of its flower. This is exceedingly sweet-scented, and from it are made perfumed waters and essences, which surpass in gratefulness those of the lemon, sweet orange, or citron.

This finishes the description of the four primitive species into which the numerous family of the *Citrus* is divided.

Before undertaking the description and identification of their derivatives, it is necessary to establish the acceptation of several terms which have been adopted by botanists, agriculturists, and gardeners to designate some different races whose characteristics have not been well determined. We will examine the meaning of the words *lime*, *lumie*, and *poncire*.

It is difficult to determine with exactness the idea attached to each of these terms, and still more difficult to follow out all their application to various races by different writers; but we shall not have much trouble in recognizing that all these names have only been invented in order to designate the hybrids which we meet with every day in our gardens, and which could not be called by the names already in use, because these names belonged to the species and their varieties. As, however, the origin and nature of these fruits was little known, they were unable to employ systematically the names which they have assigned indefinitely to individuals of very different nature.

Ferraris seems to designate, under the name of *lime*, nipped fruits derived from the orange and the lemon, and under the name of *lumie*, hybrids of large, round fruit with a yellow, thick skin, and a very sour thin pulp. But in practice he does not always make this distinction, and, for example, places among *limes* the lemons called sweet as well as those of an orange pulp; and after having classed among the *lumies* the Adam's apple, under the name of *lumia valentina*, and other hybrids of several forms, and having a citron peel, he describes, under the name of *limes*, orange-lemons, of which several resemble

and are confounded with his *lumies*, such as the *lima dulcis*, which he puts in the same class as the *Citrus aurantiatum*, or cedrat of China, which he calls *lima citrata*, *scabiosa* et *monstruosa*.

He subsequently confounds these same races of fruits with lemon-cedrats and poncires, which he regards as different species, although these terms are also considered as only synonyms representing equally the same hybrid.

In the midst of this confusion, however, we find that all writers have recognized under these same names of lime, lumie and poncire, the hybrids of the *Citrus* family, although each one has had a separate definition for them. These are the terms applied to hybrids in Italy, France, Spain, and Portugal.

We shall, therefore, follow this nomenclature, and in order to give to it more precision, we will designate the poncire as the hybrid of the lemon and the citron or cedrat; the lime as the hybrid of the orange and the lemon; and the lumie as the hybrid of the citron and the orange.

We shall subdivide these three races of hybrids into two classes.

The first comprises hybrids which have preserved all the physiognomy of the principal species, from which they are distinguished only by very slight modifications hardly affecting any part of the plant.

The second class comprises those hybrids in which the mixture is so pronounced that they cannot be confounded with any of the varieties of the primitive species.

We shall retain for the first class the name of the species to which they belong, accompanied by an epithet indicating the modification which distinguishes them; such are the Chinese citron, which we will call the *monstrous citron*, and the cedrat of Florence, which we shall still call the citron of Florence.

The second class will preserve the names of lime, lumie, and poncire. We shall, however, be careful to arrange the different varieties under the species which predominate in the mixture, and to which they seem most to belong. This is the method I shall follow in the following detailed descriptions of species, varieties, and hybrids.

CHAPTER III.

IDENTIFICATION AND DESCRIPTION.

ART. I.—The Citron Tree.

The citron tree was for several centuries a constant species, preserved in Europe without hybrids or varieties. Thus Theophrastus, Virgil, Pliny, Palladius, Crescentius, &c., represent it. As soon, however, as its cultivation was extended and it was multiplied by seed, it gave varieties; and it produced hybrids also so soon as it was placed in the same soil with lemon and orange trees. Hence the three varieties of Mathiolo and Gallo, and the more numerous ones of the Arabic agriculturists; hence also the infinite races of later writers, who have classed among the species of the citron tree the multitude of monsters which reappear every day without ever resembling each other, and which are hardly ever perpetuated.

Ferraris reports eight species of this tree, and

gives plates of five, of which three are monsters.

Commelyn gives four species of it, of which two are only monsters.

Volcamerius gives ten species, of which several are only monsters, and others are sub-varieties or varieties represented twice.

The plan we shall follow simplifies this nomenclature, and causes the most of these above-mentioned races to disappear.

There is only one type; but hybrids are numberless, which it is impossible and useless to follow, and which must be reduced to those whose peculiarities are most remarkable.

The citron of Media, known in Liguria as the citron of the Hebrews, or the Hebrew citron, is certainly the type.

There are only three varieties deserving mention: the citron of Genoa, which surpasses the type in size, but is inferior to it in taste and delicacy; the citron of Salo, which surpasses the type in delicacy and aroma, but is inferior to it in volume; and the double-flowered citron, remarkable for its double or semi-double flower, and so prone to irregular fecundation as often to produce monsters.

The hybrids seem innumerable, because they present a gradation of shades of difference in their physiognomy, which is as varied as the combinations from which they result; but when accustomed to seeing them, one easily perceives that there is a determinate number of mixtures to which all may be referred.

I will begin by dividing them into two classes—hybrids and semi-hybrids. I understand by hybrids those in which the mixture has sensibly altered the natural physiognomy of the species, and by semi-hybrids those in which this mixture is so slight as to be determined only with great care. I will place in this article only the last class, and discuss the first class under the articles concerning the respective species which predominate in the mixture.

The semi-hybrids of the citron tree are only three: the citron of Florence, the citron of China, or the orange-citron, and the sweet citron. All the other citrons with which the Hesperides of Commelyn are filled are only sub-varieties differing only by insensible peculiarities, which appear and re-appear successively, or else isolated monsters, which are only fruits of which every tree produces some annually in the midst of ordinary fruit, but which are not perpetuated by their seed. Among the first, the sub-varieties, are the citron of Corfu, whose fruit is so small and ordinary that it is called in the country the *cedro mazza-cani*. The cedrat of Holland, the cedrat bergamotte, the cedrat oviform, the cedrat of Garda, the cedrat musciato and the dorato, names given by Volcamerius, are only lemon-citrons, whose family is so numerous and varied that I might easily describe twenty varieties of them now growing in my garden, produced from seed, and which I regard as unworthy to be perpetuated by the graft, because they possess no characteristic rendering them extraordinary.

*The species with monstrous fruits completes the list of the Hesperides.

At the present time I know of but very few

among the citron trees which form monstrous varieties. The lemon and the orange present plants, of which the fruit is striped, starred, &c., but the citron produces no other than fruit which is tuberculous, a form peculiar to this species. The fruits shaped like a hand, or crumpled around the nipple; those which enclose within themselves another fruit with its rind, or only a multitude of cells crossed and confounded one with another, all appear upon ordinary trees only in the midst of other fruits; and, far from owing their form to the nature of the plant which bears them, they are the result of an extraordinary and irregular fertilization, which has acted upon the thin skin (pericarp) of the individual fruit.

Thus it becomes necessary to place in the class of monstrosities the five varieties spoken of in the Hesperides by Volcamerius, on pages 41, 45, 65, 116, 117.

These extraordinary fruits appear more frequently among certain varieties, yet but a few of these monsters are found, in the midst of a great number of fruits whose forms are unaltered.

VARIETIES—NO. I.

Citrus medica cedra fructu oblongo, crasso, eduli, odoratissimo. Citronier des Juifs. (Cedrat.)

Cedro degli Ebrei, vulgo. (Pittima.) *Malum citreum maximum* Salodiamum: *Cedro grosso* bondolotto. (Volc.) *Cedrato ordinario*. (Ib.)

Citreum vulgare. (Tournef.) *Limonia cedra* fructu maximo, conico, verrucoso, sapore, et odore insigni. (L. B. Calvel.)

Citrus medica: *cedro*: *cedrato*. (Targ. Inst. Bot.)

Citrus medica cedra. (Desfont, Tab. de l'Ecole de Bot.)

The cedrat, properly speaking, or citron of Media, is a tree of medium height, with a root greatly branched or ramified, yellow outside, whitish within.

The general appearance of the tree is irregular and scattering. The trunk is of a greyish green, striped with white. The wood is hard, and branches tough, short, and well grown. The buds are large, prominent, and furnished with a single thorn, short and thick. The shoots, or scions, violet at their budding, change finally to green. The leaf is long, regularly pointed, and almost as large near the extremities as in the middle; it is of a beautiful green, bitter to the taste, and odorous. The flowers are in clusters—cup-shaped, large and full—having five white petals shaded on the outer side with purple, and thirty or forty stamens; the anther oblong, and clear yellow; the pistil, large and long, rests upon the ovary. Some of the flowers, lacking this part, fall off. The flower has a feeble odor, and yields very little essence.

The fruit is large and oblong, carrying sometimes the pistil upon its point. The rind is yellowish, thin, glossy, a little uneven, and contains delicious aroma. The inner skin is thick, tender, aromatic, rather sweet, and may be eaten with sugar, or made into conserves. This skin adheres very closely to the pulp, which is thin, composed of an infinity of whitish vesicles, containing a slightly acid, yet somewhat insipid juice, and enclosing a great number of oblong seeds covered by a reddish skin, and formed of a whitish and bitter kernel. The citron tree of Media is grown in Liguria only from slips; these root very easily. It is sometimes grafted upon the bigarade (sour orange).

It bears but little fruit, and fears extremely the

*Up to this point Prof. Wilcox had translated this work at the time of his death. The translation has been completed by Mrs. C. A. Covgill, of Tallahassee, Fla.

cold. It blossoms almost continually, and chiefly in winter. The fruit is sold in autumn and in winter for preserves, which are delicious. It is bought in summer by the Jews, who use it in August for their Feast of Tabernacles.

This tree is cultivated largely at San Remo, San Steffano, and Taggia (Department of Maritime Alps), and there is a fine tree in the Jardin des Plantes, Paris.

VARIETIES—NO. II.

Citrus medica cedra fructu maximo Genuensi.

Citronnier a gros fruit.

Cedrone.

Malum citrum Genuense vulgare. (Vole.)

Citrum Genuense magni incrementi. (Fer. Hesp.)

The citron of Genoa differs but little from the citron of the Jews, except in its fruit, which is extremely developed, and of which the flesh is tough and less delicate. This variety is cultivated for its beauty, rather than its use to the confectioner, at Tazzia, St. Remo, and at Menton.

VARIETIES—NO. III.

Citrus medica cedra fructu parvo Salodiano.

Citronier de Salo : Petit cedrat : Cedrino : Cedratello. Citrum Salodianum parvum, bonitate primum. (Fer. Hesp.)

Cedrato di Garda. (Vole., part 2.)

The small citron of Salo is a very fine fruit, sought after for the aroma of the outer and for the delicacy of the inner skin. It originally appeared at Salo, on the Lake of Garda, where its culture is very extensive.

It is also cultivated at Nervi, at Pegi, and at Final, where it is called *cedrino*.

It differs from the citron of Florence only in the leaf, which, in the latter, resembles that of the lemon, while that of Salo has an entirely citron leaf; and in the form of the fruit, which is a little more ovate. Some pretend that this is inferior in taste and perfume to the citron of Florence.

VARIETIES—NO. IV.

Citrus medica cedra flore semi-pleno.

Citronnier a fleur double.

Cedro a fior doppio.

Malum citreum flore pleno, et fructu prolifero: Cedro di fior e frutto doppio. (Vole.)

The double-flowered citron is a variety due to a superabundance of fructification, modifying the germ in its formation.

It is improperly called a double flower, as it is seldom that these flowers are truly full and without stamens. They are usually but semi-double, and often yield monsters, having inside a second fruit.

We shall have occasion to observe that this phenomenon is very frequent in the varieties having semi-double flowers.

HYBRIDS—NO. V.

Citrus medica cedra fructu monstruoso aurantiato, cortice crasso mucronato, medulla exigua, seminibus carente. Cedrat monstrueux, ou cedrat de la Chine.

Citrus medica tuberosa: Poncire. (Desfont.)

Lima citrata monstruosa sive scabiosa. (Fer.) Lima Romana. (Miller.)

The large orange citron is a plant having short and stiff branches, flattened at the axil of the leaf.

These branches have many knots or joints closely placed, bearing large buds, which often develop into many shoots. The leaves, based upon a large and scoop-shaped petiole, are fleshy

and of a deep green color; they are ovate in shape, without points, and are often quilled at their edges like the lip of a vase. The flowers are in clusters, their corollas being red on the outside.

Its fruit is of the size of the largest citron, being often seventy centimetres (nearly twenty-eight inches) in circumference. Ordinarily they are nearly round, somewhat pointed at the apex, where the rind forms itself into a fold, and penetrates to the middle of the inner skin, and even to the pulp.

The outer skin, or rind, is of a pale orange color and very uneven, being covered with large bunches.

The inner skin, which forms the body of the fruit, is white, coarse, and leathery. Its pulp is thin and acid, and never contains seed.

This citron tree is multiplied by graft, and also grows very easily from layers, but is seldom cultivated in Liguria, except by amateurs and nurserymen. A plant may be seen in the Garden of the Museum of Natural History, Paris.

HYBRIDS—NO. VI.

Citrus medica cedra aurantiata, folia oblonga, petiolo nudo, flore candido, fructu medio sub-rotundo, cortice crasso, crasso, exterius croceo, intus albo, satisque tenero et in cibatu gratissimo; medulla colore auranti, jucunde, dulci.

Cedrat a fruit doux.

Cedrato dolce.

Malum citreum dulci medulla. (Fer. Hesp.)

The sweet-fruited citron is a genuine lumie, uniting many of the characteristics of the citron to those of the orange. Its leaf is citron, its flower orange. Its fruit has the form of the citron, and the color of the orange, having a thick yet delicate skin which may be eaten with pleasure like that of the citron, and a juice which, modified by the influence of the orange, has a sweet and very agreeable taste.

This plant often bears monsters, enclosing within themselves a second fruit about the size of a walnut, and covered with a golden skin like the other fruits. This phenomenon is due to extraordinary fertilization, and occurs more frequently among hybrids than in the ordinary varieties; most often in varieties having semi-double flowers.

HYBRIDS—NO. VII.

Citrus medica cedra limoni folia Florentinum, fructu parvo, ad basin lato, in papilla desinente, odoratissimo, cortice flavo, intus albo tenero, in cibatu gratissimo; medulla acida.

Cedrat de Florence: petit poncire.

Cedratello di Firenze.

Limon citratus Petre sanctae. (Fer. Hesp.)

Citrum Florentinum odoratissimum. (Mich. Cat. Hort. Flor.)

Malum citreum Florentinum. (Vole.)

Citrus medica Florentina: Citronier de Florence. (Desf., Tab. de l'Ecole Bot.)

The citron of Florence has been placed by Ferraris among the lemon-cedrats, and has, in truth, characteristics proving a mixture of citron with lemon.

Its general appearance is that of the citron tree, though growing only to a shrub, and its tough branches can scarcely be made to submit to the espalier (trellis).

But the leaf is as large as the lemon, and similar to it in form and color. The leaf is remarkable because of the yellowish spots upon the clear green, peculiar to this species.

Its flower has a smaller corolla than that of the ordinary lemon and citron, and is shaded outside by a brighter red. Its fruit, of the size of an ordinary lemon, is covered with warts or *tubercules*; it is flattened on the end next the stalk, and pointed at the other end. The rind is thin, of a clear yellow, and full of a delicious aroma. The inner-skin is thick, white, and very delicate, having a pleasant taste, and may be made into delicious confections. The pulp, enclosed in nine very thin sections, is greenish and acid. This variety, which appears to be a hybrid of the lemon, is highly esteemed. It will not endure cold, and is cultivated but little in Liguria, though freely distributed through Tuscany. I have never seen it multiplied but by grafting.

ART. II.—Of the Lemon Tree.

Citrus medica limon flore polyandrio, sepe agnito, corolla intus alba, exterius rubra, folio in summa teneritate violaceo, petiolo articulat, fructu flavo, obovato, cortici tenui, medulla ampla, grate acida.

The *limonier* (or lemon tree) is a species rich in varieties, and still richer in hybrids. The type is an oblong fruit, of which the rind is glossy and yellowish; thin, and full of a caustic aroma; the inner skin, nearly useless, is white, leathery, and very adherent to the *pellicule* or thin skin which covers the sections. Its pulp is a yellowish white, abundant, and encloses a quantity of acid juice, agreeable and aromatic. It is this which makes the value of the fruit, it being useful in cookery and in the making of drinks.

This type is most often reproduced from seed, though it is very frequently modified by fertilization, and the result is an innumerable crowd of varieties, which are mingled and confounded with the hybrids of the citron and the orange. In proportion as the skin thickens, the lemon removes itself from its type and approaches the citron. I do not, however, establish upon this fact the principle that all lemons whose fruit has fleshy skin must be hybrids, for this peculiarity may reach a certain point independently of the influence of the citron; and there are lemons whose skin is thicker than the type, and yet they have not the slightest indication of the citron. These are varieties due to accidents of fecundation. The Lemon tree attaches itself also to the bigarade and sweet orange trees by a very great number of hybrids, which form the numerous class of limes. On this side, however, the line of division is more marked, and it is difficult to confound the mixed species with the varieties.

We will commence by a description of the type, choosing afterwards those varieties sufficiently marked to show their difference with their model. We will then speak of the hybrids which attach themselves to the citron tree, called *poncires*, and finally of those attached to the orange tree, called *lumies*.

To reduce them to their natural order we must place in the centre the type or model, which leans, on the one side, towards the citron, on the other, towards the orange. In passing, we take up, first, all varieties which may be remarkable; afterwards, the hybrids, which, like a chain, tie all these races together.

Turning towards the citron tree I find a large number of lemon trees whose fruit has thick,

uneven skin, nearly always oblong, and differing among themselves only in size. Of these I see but three varieties: First, the lemon, of semi-double flower, whose fruit is regularly indifferent; second, the lemon, of sour juice; and third, the lemon of sweet juice. Their sub-varieties being innumerable, I pass them by in silence. Passing on from the *varieties* I come to the *hybrids* of the citron.

I recognize but two races among them, of which each has sub-varieties, distinguished only by the size of fruit, and by insignificant changes of form. The first of these hybrids is the lemon-citron, with oblong, tuberculous fruit, called *poncire*, a *fruit ordinaire*. The second is the lemon-citron, having egg-shaped, smooth-skinned fruit, called *poncire*, a *fruit fin*. The most remarkable variety of this is the *Pomme de Paradis* (Paradise-apple).

Starting again from the original type I meet varieties which improve upon the principal species by the delicacy and odor of the skin, and by the abundance and aroma of the juice. They all have fruit nearly round. The first is the *limonier a fruit fin*, or *lustrato*, of Rome. The second is the *limonier ligurien*, or *bugnetta*. The third is the *limonier a petit fruit*, or *balotin*, of Spain.

I come finally to the hybrids of the orange, which are so numerous that it is impossible to follow them into all their modifications. I shall, therefore, divide them into two classes, hybrids of the bigarade, and hybrids of the sweet orange. At the head of the first I place the bergamot lime, and lime of Naples. I put at the head of the second the sweet lime, or the orange-colored lemon of sweet juice. All other races of this nature are but modifications of these.

Thus is shown the entire ramifications of the *limonier*, or lemon tree. Having closely examined the crowd of varieties spoken of by Ferraris and Volcamerius, and by many other writers, I find them all in those I have named; therefore I think it useless to make isolated descriptions, as they would be but a repetition, under different names, of the same objects, diversified sometimes by slight accidents unworthy of note.

VARIETIES—NO. VIII.

Citrus medica limon fructu ovato, crasso, et grate acido.
Limonier de Genes.
Limone Genovese.
Limon Ligurie ceriascus. (Fer.)
Limon vulgaris. (Tournet. Hist. Rei. Herb.)
Malus limonia acida. (G. B. Pin.)
Limonia malus. (J. Bauh.)
Limon vulgaris: Witte limoen. (Commelyn. Hesp. Belg.)
Limon vulgaris: Limon volgare. (Voic.)
Citrus medica acida: Citronier aigre. (Desfont. Tab. de l'Ecole de Bot.)

The lemon of Genoa is a vigorous tree, which will also extend itself *en espalier* (on a trellis), and bears an abundance of fruit. Its trunk, branches, leaf, and flower are like other lemons. It has no thorns, and blossoms continuously from spring till fall. The fruit, usually egg-shaped, has a skin a little thick—sometimes smooth, sometimes uneven—and an abundance of sharp, acid juice. It is very generally cultivated upon the coast of Liguria, from Spezzia to Hyeres. It is the fruit of commerce by reason of its thick skin protecting it in its transit. It is multiplied by graft, but may be raised from seed.

These trees (from seed), however, will nearly always have thorns.

VARIETIES—NO. IX.

Citrus medica limon fructu ovato, cortice glabro, tenui, medulla acidissima.

Limonier a fruit fin : lustrato.

Limone fino: lustrato.

Limon acris: Malus limonia minor acida. (H. R. Par. Tournef. Inst. Rei. Herb.)

The lemon of delicate fruit is the favorite among lemons. Its tree resembles the ordinary lemon, but its fruit, which is ovoid and large, has a remarkably smooth, glossy skin, so thin that one can scarcely distinguish the white part. Its pulp is very delicate, enclosing a large quantity of acid, agreeable juice, full of a delicious aroma. It is asserted that this fruit, coming from Rome, where it is known by the name of lustrato, bears a finer perfume than when cultivated elsewhere. At Liguria there are many varieties of it, called St. Remo, Bugnetta, and Spanish Balotin. The last has a very small fruit, having all the peculiarities of the lustrato. The balotin seems to be a product of the lustrato and lime of Naples—a lime a trifle smaller, and surpassingly rich in delicacy and fragrance. This balotin is entirely different from that which is cultivated under this name at the Garden of Plants, Paris.

The former seems to be a lemon with round fruit, differing from a lustrato only in size of fruit, while the one at Paris appears to be a lemon-citron or poncire.

VARIETIES—NO. X.

Citrus medica limon medulla, acido carente.

Limonier a fruit doux.

Limone dolce.

Limon dulci medulla. (Tournef.)

Malus limonia major dulcis. (C. B. Pin.)

Malus limonis minor dulcis. (Ib.)

Limon doux. (Miller.)

Limons doux. (Olivier de Serr.)

Limon dulci medulla: Zoete limoen van Ferrarius.

(Comelyn Hesp. Belg.)

Limon dulcis vulgaris: Ital., Limon dolce ordinario.

(Vole.) *Limon Lusitanus, dulci medulla: Limon da Portugal* dolce. (Ib.)

Limon dulci medulla vulgaris: Limon dulci medulla

Olyssipponensis. (Ferr. Hesp.) *Lima dulcis: Ital., Lima*

dolce: Limetta Hispanica dulcis. (Vole.)

Citrus medica limon: Lime douce. (Desfont. l'Ecole de Bot.)

The lemon of sweet fruit is known almost everywhere under the name of sweet lime (*lima dulcis*). Its peculiar juice prevents its being classed as a lemon. Some have given it a place among those neuter fruits whose origin is unknown, but which, when they approach the lemon, are called limes. I shall not combat this opinion, neither can I adopt it; for this lemon bears no trace of the orange, in leaf, flower, or fruit. Its juice has not, it is true, the acidity of the lemon, but it has not the sweetness of the orange, being insipid rather than sweet. This may be owing to an imperfection in the organs that renders them incapable of elaborating the sap, which nourishes it and should produce citric acid. In this case the fruit is a monster, rather than a hybrid, and this monstrosity being peculiar to the plant and common to all its fruit, forms thus a true variety, which I am forced to place in the list of lemons. I shall not enlarge upon this, but if one sees a lemon of which the juice is sweetish and the pulp extremely white, that is the sweet lime. It is divided into many

varieties in nowise distinguished the one from the other, save by the size, the shape, and the delicacy of the fruit.

The most common bears a lemon middling round, often wrinkled at the point, with a thick skin, and a white and sweetish pulp. There is a fine plant at Versailles which they call sweet-lime; it is also found all over Liguria, where they cultivate many sub-varieties, of which the most common bears a fruit with elongated point, and joined in groups of three or four upon one stalk.

VARIETIES—NO. XI.

Citrus limon flore semi-pleno.

Limonier a fleur semi-doublé.

Limon a flor semi-dopplo.

Limonier a fleur double. (Miller Dict.)

The double-flowered lemon is a tree whose flowers have many petals, but are not entirely sterile. One cannot give a description of its fruit, as it is influenced and changed by plants near it, and strangely modified in form of fruit. It has no seeds, and is very rare.

HYBRIDS—NO. XII.

Citrus medica limon fructu citrato, oblongo, cortice rugoso, crasso et eduli.

Poncire d'Espagne: *Limon* cedrat.

Limon-cedrato.

Ponciles. (Olivier de Serr.)

Poncira, quasi poma cerea. (Salmas, ad Solin.)

Limon Sponginnus. (Ferr.)

Poncires, quasi poma citri. (A. Banh, Theat. Bot.)

Limon citratus: Limon cedrato. (Vole.)

Limon citratus: Mala limonia citrata. (Tournef.)

Citrus medica Balotina: Citronier Balotin. (Desfont, Ecole de Bot.)

The lemon-citron with tuberculous fruit is a poncire, having the appearance of a lemon tree, of which the fruits, nearly always oblong, have an uneven skin, thick and edible.

They are, however, less delicate than the lemon-citrons with glossy skin, but are much cultivated in Liguria.

Its varieties are innumerable; among them we can place the *limon striatus amalphanus*, the *limon rosolinus*, and others, spoken of by Ferraris. Also the *limonium citratum* of Volcamerius, and many others.

I think we may also place in this series the variety cultivated in the Garden of Plants at Paris, under the name of Balotin. It has the same appearance and traits, and if the description of its fruit given me by the gardeners is exact it belongs to the poncires.

HYBRIDS—NO. XIII.

Citrus medica limon fructu citrato, ovato, cortice glabro, crasso, cibatu gratissimo, pulpa fere nulla acidula, vulgo Pomum Paradisi.

Poncire di San Remo, or pomme de Paradis.

Limon cedrato fino: poma di Paradiso.

Pomum Paradisi. (Ferr.)

Limon citratus: limon cedrato. (Vole.)

The lemon-citron, with smooth skin, is the tree commonly known as poncire. It has the appearance of a lemon tree; its fruit, egg-shaped, has the glossy rind of the lemon, while its inner skin, thick, like that of the citron, is of a dazzling whiteness and an exquisite delicacy. It may be eaten raw with sugar, or as a conserve. In Liguria, where the people are gourmards with this fruit, it is in every garden. There are trees bearing fruit larger than the largest citrons. The favorite variety is called Paradise apple. It is a poncire much larger than a lemon, and with skin

so thick that it has scarcely any pulp. I shall not give the description of all the varieties spoken of by Ferraris and Volcamerius. They all resemble this one, and are marked by the same traits.

The poncires are always seedless. I have never yet found one in them.

HYBRIDS—NO. XIV.

Citrus medica limon aurantiata fructu ovato, croceo, medulla dulcissima.

Lime sucrée.

Limone aranciato: lima dolcissima.

Limon saccharatus sive dulcissimus; limon zuecherin dolce. (Volc.)

The sweet lime, or lemon with orange pulp, is a hybrid which has preserved all the traits of the lemon in the leaf and outside of fruit, while the pulp is sweet like the orange.

This variety is nearly the same as the *limon saccharatum confierum* of Volc., and the *limon lusitanie augustalis dulci medulla*, of the same writer. In Liguria a great number of these hybrids are cultivated, but in passing from one garden to another one cannot but observe that by slight changes they have been modified infinitely.

HYBRIDS—NO. XV.

Citrus medica limon aurantiata fructu parvo, suavissime odorato, vulgo, Bergamotto.

Lime Bergamotte.

Limone Bergamotto.

Limon Bergamotta, alis aurantium Bergamotta. (Volc.)

Citrus medica Bergamium: Oranger Bergamotte. (Desf., Tab. d'Ecole de Bot.)

The bergamot is a plant growing to very little height, and preferring the open air to the espalier.

Its branches are long and pliant. The leaves, often a little quilled, are based upon a long petiole, often winged like that of the orange, and resemble those of the bitter orange in form and color. Its flower is white, and has twenty stamens, as in the orange. Its fruit is small—sometimes with a little nipple or *mamelone* at the point, and often in the shape of a pear. It yellows at maturity, and takes the figure and color of the lemon.

Its skin, glossy and thin, contains in the vesicles with which it is filled, an essential oil, of a sweet and sharp odor, which makes the value of this variety; its pulp, sharply sour and bitter, is of no use.

In these characteristics it is easy to recognize a hybrid of the lemon and orange. One finds the first in the fruit; the second, in the leaves and flowers.

But the bergamot improves upon these two species by the sweetness of its perfume, which is delicious, and of which the choicest essences are made. Writers upon agriculture have been in doubt as to the origin of this odor, it not being found in the lemon or orange; and some have advanced the theory that the variety was the product of a lemon graft upon a bergamot pear, with the fruit of which, however, the odor of this agrume has no connection. But we are now convinced that, with the same principles differently combined, Nature diversifies greatly her products, and, consequently, it is very probable that the combination of the odorous principles of the lemon with those of the orange may give a result still more exquisite than either alone. I have noted this phenomenon in the most of the mixtures of the genus *Citrus*.

The citron of Naples, for instance, has certainly an aroma more exquisite than that of either lemon or orange; and the lime of Florence is a poncire surpassing in odor the common citrons. The same may be remarked with regard to the Paradise apple, of which the skin surpasses in abundance and delicacy that of even the type of the citrons, or of the citron of the Jews.

HYBRIDS—NO. XVI.

Citrus medica limon aurantiata fructu pusillo, globoso, cortice glabro, tenui, odorato, medulla acida, graticissima.

Lime de Naples a petit fruit.

Limonecillo di Napoli.

Limon pusillus calaber. (Ferr.)

Limon pusillus calaber: calabrese limone. (Commelyn, Hesp. Belg.)

Limon calaber: limon calabrese. (Volc.)

The lime of Naples is a small lemon, which takes after the orange, of which it is a hybrid. It does not attain a great height, and, unlike the lemon, its slight, yellowish branches will not submit to be trained *en espalier*.

Its small and deeply-colored leaves have the winged petiole; the thorn which grows at their axil is so early and so invariable, that it is with great difficulty suitable buds for grafting can be detached. The flower is small and entirely white. The fruit—smallest of European lemons—is round, having the pistil at its extremity, and a yellowish, smooth, and very thin skin, which is odorous. Its pulp is abundant; its juice acid and agreeable, because of its delicacy and aroma. This is one of the most highly esteemed lemons.

It has no seeds, but is multiplied by a peculiar kind of grafting, on account of the thorn rendering it difficult to procure a suitable bud.

Volcamerius describes two varieties of it; one very much like this. The first—that he calls *balinus Hispanicus, ballotin di Spagna*, and of which the leaf is narrow and flat; the fruit yellow, round, and small; the pulp green; and juice plentiful, acid, and pleasant—is but a variety of lustrato.

But the second, that he calls *limon irritator appetentie; limon aguzza appetito*, is surely a hybrid of the bigarade, a true lime, in which the traits of the two species are well based and closely united.

The flower is small and white; the fruit, about the size of a walnut, is round, and carries the pistil upon its point. It is covered by a red and very thin skin, smelling of musk. The juice is sour, but pleasant.

ART. III.—Of the Bigarade Orange.

Citrus aurantium Indicum, flore icosandro, corolla alba, folio petiolo alato, fructu globoso, aureo, medulla acri et amara.

Bigaradier; Bigarade.

Arancio forte: Arancia forte.

Narendj (orange). (Avicen.)

Narendj (orange). (Abd-Allatif, in Egyptian and Arabian traditions.)

Oranges: Poma citrina acidi seu pontici saporis. (Vitrac, in Oriental Hist.)

Arangias. (Hug. Falc., 1169.)

Acripomum: vulgo Arangia. (Nicols., 1069.)

Arangi: Aïrange: Orange. (Gloss. of the Roman language by Roquefort.)

Melarangia. (Calvan., 1738.)

Aranza. (Ib.)

Citranguli sive Cetrone. (1472.)

Citrul. (At Savona, 1468.)

Citrone. (Glust. Hist. of Genoa.)

Oranges. (Jouan. in voyage of Chas. IXth to Jerusalem.)

Oranger : Oranger cornu, or Bigarat. (Oliver de Serr.)
 Medici. (Meral.)
 Aurea malus : Mala arantia. (Bauhin.)
 Citrus Narendi. (Forsk.)
 Citrus aurantium : Arancio forte. (Targ.)
 Citrus aurantium : Citrus petiolis alatis. (Lin.)

The bigarade presents a ramification of very many true varieties and few sub-varieties. It would seem that this species, more constant in the reproduction, changes from it only to diversify it in a very marked manner. It will, therefore, be easier to give a description of its derivatives, even to the hybrids.

The type is known under the name of bigarade, *aurantium vulgare medulla acri*. Its varieties are six in number.

First. The type.

Second. The bigarade of double flower.

Third. The bigarade with willow leaf.

Fourth. The Rich spoil.

Fifth. The little Chinese.

Sixth. The Chinese with myrtle leaf.

The hybrids number seven.

The two first are the result of the mixture of the bigarade with the orange; the third and fourth are the product of the citron impregnated by the bigarade; the fifth and sixth result from the orange modified by the lemon; the seventh is a singular variety, in which is found united the three species, citron, orange, and bigarade. We begin by describing the type of the species.

VARIETIES—NO. XVII.

Citrus aurantium Indicum, vulgare fructu acido.

Bigaradier: Bigarade.

Arancio forte: Arancia forte.

Aurantium vulgare medulla acri. (Fer.)

Aurantium vulgare fructu acido.

Aranzo silvestre. (Volc.)

Gemeene of Zuure oranje appel. (Com.)

Malus aurantia major. (Bauh.)

Aurantia mala. (Cam.)

Oranger sauvage or sauvageon. (Tournef.)

Citrus narendi malech (bitter orange.) (For.)

Aurea malus fructu acido. (Clus.)

Arancio salvatico : Arancio da premere.

Citrus aurantium petiolis alatis. (Lin.)

The bigaradier is a species which grows to a tree of round and pretty form. The leaf, thin and lanceolated, has the petiole furnished with two wings, which are more pronounced than in the sweet orange. But nothing so much distinguishes it from that as its flower, which is, in the bigarade, more sweet and more abundant in perfume. In fact, it is only for its flower that the tree is cultivated in Paris, in the cold provinces, and in a part of the southern districts, where they distil from the flowers a sweet and delicious perfume. At Grasse, at St. Remo, and at Nice, they cultivate it solely for this.

It is cultivated for its fruit in Tuscany and in Rumania, where it is used like lemons for seasoning vegetables and fish. This is the only use to be made of this fruit, as its skin encloses in its vesicles a caustic aroma of insupportable bitterness; and its juice is both bitter and acid.

The gardeners in Paris speak of a number of sub-varieties of the bigarade, which are but little noticed in the south. But these gardeners agree so little in the names that they give to the trees, as well as in their characteristics, or the accidents which mark them, that it is difficult to decide upon their nature. They have generally in view, in their classification, the more or less great abundance of flowers borne by these varieties, and

I have observed that this difference in the flowering is more apparent than real, depending upon the relative nearness of the flower-buds. The blossoming thus seeming to be more or less abundant, according to the intervals between the buds.

The names given are not always suited to the nature of the tree; for instance, they call one the bigarade with *grey* flower, of which the flower opening very quickly does not show the anthers as yellow as in the ordinary bigarade. They give the name *crowned* bigarade to another whose fruit has often a small nipple at its point. They call one Adam's apple, of which the leaf is a little less lanceolated, and the buds very close together and no thorn. Finally, they name one *horned* bigarade, a common bigarade which sometimes bears monsters having the shape of a horn. All these varieties differ so little as to be scarcely worth the trouble of describing.

The bigarade is usually the tree upon which is grafted the other species of agrumi. Sometimes it is grafted upon itself, in order to produce a smaller tree suitable for vases.

In Liguria it is called *margaritino* or orange of St. Marguerite.

VARIETIES—NO. XVIII.

Citrus aurantium Indicum flore semi-pleno, fructu saepe, fetifero, medulla acida.

Bigaradier a fleur double et semi-double, a fruit souvent monstrueux.

Arancio forte a fior doppio e semi-doppio, e a frutto spesso fetifero.

Aurantium flore duplice. (Ferr., p. 387.)

Aurantium flore pleno.

Aranzo con fior doppio. (Volc., p. 201.)

Aranzo di fior e scorza doppio. (Volc.)

Oranger a fleur double. (Millar.)

This variety has improperly been called double flowered. It is very seldom that these flowers are full of petals; usually they are but semi-double, and yield very often monstrous fruit, enclosing within themselves a second fruit. We have already observed that this phenomenon is very frequent in these monstrous varieties.

VARIETIES—NO. XIX.

Citrus aurantium Indicum salicifolium.

Oranger a feuille de saule, or Tsquoishe. Arancio a foglia di salice, or Arancio Turco.

Aurantium angusto salicis folio dictum. (Boer.)

The Turkish orange is but a bigarade, whose leaves, lanceolated and pointed, are very straight and long like those of the willow. Otherwise it has all the traits of the bigarade, both in flower and fruit; the latter is sharp and bitter, and has the form and color of the bigarade.

This tree is not cultivated in Liguria, except by collectors of varieties, and by the seedsmen of Nervi, who multiply it by graft for their trade in plants. A specimen of these trees may be seen in the Garden of Plants at Paris.

VARIETIES—NO. XX.

Citrus aurantium Indicum crispifolium multiflorum fructu parvo, amaro et acido.

Bouquetier or Riche depouille.

Arancio a mazzetto.

Aurantium crispo-folio. (Fer., p. 387.)

Aurantium crispo-folio. (Tournef.)

Aranzo a foglie rizza. (Volc.)

Oranger a feuilles frisées. (Millar.)

Citrus aurantium multiflorum.

Oranger riche depouille. (Desfont.)

The orange with curled leaf grows as a shrub; its boughs are short, straight, and bushy; its

buds or shoots are very close together, bearing a quilled ovate leaf which covers the stem on all sides, and gives to the tree the rounded and pointed form of a cone. The flowers come out of these shoots in great numbers, appearing to cover the bough on all sides, thus forming a very large and beautiful bouquet. The fruit is a trifle larger than the small Chinese orange, which it closely resembles in taste and smell. It is a bigarade of small fruit, cultivated in Liguria among collectors and seedsmen. There is a specimen of it in the Garden of Plants in Paris, and I have observed one at the Tuilleries which surpasses in size and beauty all I have seen of this race in the south.

VARIETIES—NO. XXI.

Citrus aurantium Indicum caule et fructu pumilo, cortice et medulla amara, succo acido.
 Oranger nain : Petit Chinois.
 Nanino da China : Chinotto : Napolino.
Aurantium Sinense pumilum : (Vole.)
 Aranzo nano garbo.
 Pomini di Dama.
Aurantium Gommum pumilum : *Aurantium Sinense* : *Malus aurantia humilis* : Oranje-boom met de Kleine vrucht anders naantje. (Com.)

The dwarf orange is a most desirable variety for ornamenting houses and gardens, being a shrub, and dwarfed in all its parts. The stem, the boughs, the leaf, the flower, and the fruit are all small. In vases it attains to the size of a rose bush, and in the open air it grows only to the height of about seven feet.

Its branches have the appearance of nosegays ; this is owing to the proximity of the buds, and to the leaf and flower alternating.

They have no thorns, and bear a very odorous flower. The fruit, sour and bitter, is about the size of a small apricot, and is excellent for conserving.

The dwarf orange is cultivated at Morviedro, in the Kingdom of Valencia, where the skin is an article of trade, the cut and dried peel being used as seasoning of food. It is also largely cultivated in Liguria, principally at Savona, from whence in early days the Genoese manufacturers of confits were furnished with this fruit.

VARIETIES—NO. XXII.

Citrus aurantium Indicum caule et fructu pumilo, myrtifolium.
 Oranger nain a feuilles de myrte.
 Nanino da China a foglia di mirto.
Aurantium myrteis foliis Sinense. (Ferr.)

The myrtle-leaved dwarf orange is a sub-variety unknown in Europe at the middle of the seventeenth century. Ferraris reports it as a species peculiar to China. Commelyn and Volcamerius make no mention of it. It is now cultivated in Tuscany and Liguria by the amateurs, but solely for completing their collections, and also by seedsmen for their trade in plants.

There is a tree in the Jardin des Plantes at Paris, and another at Malmaison. This orange has all the traits of the little Chinese orange, the one difference being in the shape of the leaf, which is more pointed in this, and might at first glance be taken for the myrtle.

HYBRIDS—NO. XXIII.

Citrus aurantium Indicum medulla dulcacidia, cortice crasso et amaro.
 Bigaradier a fruit doux.
 Arancio forte a medolla dolce : in Liguria Margaritino dolce.

Aurantium vulgare fructu dulcacidio. (Vole.)
Aurantium vulgare : sapore : medio. (Fer.)
 Orange participant de l'aigre et du doux. (Oliv. de Ser., p. 763.)

The sweet-fruited bigarade is a hybrid of the orange and the bigarade, preserving the traits of the latter in its rind, which is thick, uneven, and bitter ; while the pulp, enclosed in a skin equally bitter, is, notwithstanding, sweetish.

It is cultivated in Liguria for ornament, and is found only among amateurs. The seedsmen do not multiply it, as it is not much sought after. It is, perhaps, one of the hybrids longest known.

HYBRIDS—NO. XXIV.

Citrus aurantium Indicum fructu magno, cortice crasso sub-dulci, medulla acidia.
 Bigaradier a corce douce.
 Arancio forte a frutto grosso e scorza mangiabile.
Aurantium dulci cortici. (Fer., p. 433.)
Malus aurantia cortice eduli. (Banh.)

The bigarade of edible skin of Ferraris seems to be a hybrid of the sweet orange. Neither Commelyn, Volcamerius, or Millar make mention of this fruit. That of which Clusius speaks has sweet juice. I do not know where the variety with sour juice is cultivated. Perhaps it is a lost variety, which can, however, reproduce itself if one sows the seed of sweet oranges which have grown in the midst of bigarades. This is my reason for giving it a place in this catalogue.

HYBRIDS—NO. XXV.

Citrus aurantium Indicum citratum fructu magno, cortice aureo, crasso, amaricante, medulla acidia et amara.
 Lumie orangee.
 Lumie aranciata.
Aurantium citratum. (Ferr., p. 423.)
Aurantium maximum : Arancio della gran sorte. (Vole., p. 383.)

The oranged-lumie, or the citroned-orange, is a hybrid partaking of the orange, the citron, and the lemon. Its leaf, deep-colored, large, and curled, approaches in form that of the Adam's apple ; the flower, shaded with red, belongs to the lemon ; the fruit, very large, round, and flattened, is very much like that of the orange. Its skin is uneven and bumpy like that of the citron, the color being a tint between that of the citron and the orange, and detaches itself readily from the sections, which are also very easily separated from each other ; the pulp, whitish and acid, resembles that of the lemon.

This description is of one in my possession, and which appears to me to be a sub-variety of Adam's apple. It differs by some accidents from those spoken of by Ferraris and Volcamerius, which also differ from each other ; but it is necessary to say that these hybrids preserve themselves intact only when multiplied by the graft ; those which come from seed are always changed by the different proportions of their combination ; thus one meets very rarely the same varieties. But, by following the principles that we have suggested, it is easy to determine their traits, and by them to place the fruit among the lumies, the limes, or the poncires. Each person can do it for himself, and connect them, without difficulty, to their analogous classes.

HYBRIDS—NO. XXVI.

Citrus aurantium Indicum fructu maximo, citrato, vulgo pomum Adami.
 Lumie d'Espagne : pomme d'Adam : at Paris, pompooleon.
 Pomo d'Adamo : Adamo.

The greater number of botanists have con-

founded the Adam's apple with the pompolmoes or pampelmous, and have joined the two under the name of *Citrus decumanum*.

Sloane, in his work on Jamaica, gives us a figure and description which is entirely suited to the genuine Adam's apple, afterwards adding that there exists a variety having the color and flesh of the orange. He characterizes in like manner and connects the two species in his Latin Synonyms. I have preserved in this article only what belongs to the Adam's apple, leaving for the article upon the Pampelmous, that which is peculiar to it. Rumphius, like Sloane, confounds them in his *herbarium amboinense*, and these writers have been imitated by Linnæus and the botanists who have followed him.

Adam's apple is one of the hybrids earliest known. We find a description of it in the History of Jerusalem, by Jacques de Vitry, and in the greater part of the works by Arabian authors, who knew it under the names of *laysamou* or *sambau*.

Marco Polo found it in Persia in 1270. It was known as *Adamo* by the ancient Italian writers upon agriculture, such as Gallo and others, and by the Spaniard, Herrera, under the names of *toronjo* or *samboas*. Mathioli calls it *lumia*; Ferraris calls it *lumia valentina*, a name also given it by Volcamerius.

This fruit is known in Liguria under the different names of *pomo d'Adamo*, of *pompoleon*, and of *decumano*. At Versailles it is called *pompoleon*; also by the gardeners of Paris.

Adam's apple is reported under the name of *Citrus aurantium maximum*, in the Table of the Botanical School, belonging to the Museum of Natural History at Paris, where are cultivated several fine and vigorous trees.

It appears to be a lumie, or a hybrid of orange and citron. (I have placed this among the lumies, because it shows traits of them; but I own that I have never tested it by the seed-bed, as I have done with all other races which give seed. I propose to try it at once, and shall not be surprised if the result shows, in this plant, a fifth species of agrume. I have already many reasons for supposing so.) The tree resembles the Chinese citron. Its branches short, often flattened, bear large leaves, which are sometimes lanceolate, sometimes notched at their edges (*crenated*), sometimes quilled. They are of a very deep green, and have two very prominent wings to the petiole. The flower, arranged in large clusters, is very large and fleshy, like that of the citron, and entirely white like that of the orange, having thirty or forty stamens. The fruit is round, and four times larger than the common orange. Its rind, smooth as an orange, is green at the commencement, and at maturity is a pale yellow. It is thin, and marked in places by slight clefts, as if it had been bitten. To this peculiarity it owes its name of Adam's apple. Under this skin, which is insupportably bitter, one finds a second, like the citrons, thick, white, leathery, and bitter. This encloses a pulp divided into eleven very small sections, which contain an insipid, slightly acidulated juice. The seeds are covered by a reddish pellicle, and are formed by two whitish cotyledons.

This variety is cultivated in Liguria only by amateurs and seedsmen, and is multiplied by

grafting upon the bigarade. At Salo it is grown from seed, but is used only as a subject upon which to graft the orange.

There are many plants of it at Versailles, at the Jardin des Plantes, and in the gardens of Paris.

The fruit is good for nothing, and is sought for its beauty only, as it is neither edible when raw, nor agreeable for confits.

HYBRIDS—NO. XXVII.

Citrus aurantium Indicum folio petiolo alato, sorpe in summa teneritate violaceo; flore hinc albo, inde exterius rubente, fructu violaceo, medulla acida.

Bigaradier a fruit violet.

Arancio forte a frutto violetto.

Citrus aurantium violaceum: Oranger violet: (Desfont., Tab. de l'Ec. de Bot., p. 193.)

The violet-fruited Bigarade is a singular variety, and very little propagated. It is not spoken of by Ferraris or Volcamerius, neither is it in the works of botanists who immediately followed or preceded them. We find it described only by a few modern writers.

I have seen the fruit only in a painting owned by M. Michel, (editor of the "Treatise upon Trees,") who obtained it from the heirs of the celebrated Duhamel; and the plant in the orangery of the Museum of Natural History, Paris.

This, which is a fine plant, has the appearance of the ordinary bigarade, having the same leaf. One would not notice anything remarkable, unless that the top is a little more bushy.

I should have classed it among the varieties of the bigarade, had not the spring growth revealed to me a phenomenon, which convinced me that it was but a hybrid.

Its shoots are of two kinds; the one are whitish as those of the orange, the others are of a very deep violet color, as those of the lemon. This violet color characterizes also a part of its flowers, which grow upon the same branches with those entirely white. Its fruit is likewise shaded with violet in the same way in which the red orange is shaded with blood color. I do not know the nature of its pulp. I am told that it is yellow and sharp, as in the bigarade.

It is easy to conceive that this variety owes its origin to the influence of the pollen of the lemon tree upon the seed from which it has come.

It is one of the most singular results of impregnation.

It is desirable that this hybrid be multiplied, on account of the beauty of both fruit and flower.

HYBRIDS—NO. XXVIII.

Citrus aurantium Indicum fructu stellato.

Bigaradier a fruit étoilé.

Arancio melarosa.

Aurantium stellatum et roseum. (Fer., p. 363.)

Aranzi stellati. (Volc., part 2, p. 190.)

Citron melarosa. (Calvel, n. 12.)

The starred orange is a fruit whose rind presents ribs a little raised, running from the peduncle or stem, and ending in a small mamelon or nipple, which crowns them.

These fruits are known in Liguria by the name of *melarosa*, because of an odor of rose which some pretend to find in them. This plant is small, and the branches thin and pliable; the leaf is oblong and lanceolate, with winged petiole; the fruit is small and flattened. Its rind, divided

into many raised ribs, has the color of a lemon, and a sweet odor slightly resembling that of the bergamot. The pulp is white, and juice acid, enclosing many seeds. This variety seems to belong to the class of hybrids. It takes after the orange in leaf and form of fruit, and after the lemon in color and acidity of juice. Its odor, very sweet, is apparently the result of the combination of the odorous principles of these two species.

HYBRIDS—NO. XXIX.

Citrus aurantium Indicum limo-citratum, folio et fructu mixto.

Bigaradier limo-citre a fruit melange, ou la Bizzarrie.
Bizzaria : Arancio di bizzaria.
Mala limonia-citrata-aurantia, vulgo la Bizzaria. (Petrus Nato. Florentie, 1674.)
Orange hermaphrodite : (Et. Calvel.)
Bizzaria : Cedrati della bizzaria. (Vole., t. 2, p. 171.)

The mixed-fruit bigarade, or the bizzarrie, is, perhaps, the most pronounced, and the most singular of hybrids.

It was discovered at Florence in 1644 by a gardener who had obtained the plant from seed, and not dreaming of the phenomenon which lay hidden in it, he had condemned it, according to usage, to be grafted. Happily, after some years, the graft perished, and the forgotten tree, already adult, sent forth wild branches which produced these marvellous fruits. The gardener, surprised, multiplied the new variety by the graft, and made it quite profitable to himself. He making a mystery of its origin, everybody thought that the wonder was owing to the industry of the gardener, who had mingled by the graft the buds of these three species. But the singularity of the phenomenon attracted the attention of philosophers, and a physician succeeded in obtaining from the gardener the avowal of the true origin of this tree.

To Pierre Nato, a doctor of Florence, we are indebted for this anecdote. He published at this time a very learned dissertation upon this hybrid, of which he gave the history and a very minute description. I have many times compared it with the specimen of the tree which I own, and also with those at Genoa, in the garden of M. Durazzo, and have found that they corresponded in every particular with the description.

The bizzarrie is a bigarade, bearing at one and the same time bigarades, lemons, citrons of Florence, and mixed fruits.

The tree looks like a bigarade. Its leaves are shaped sometimes like those of the orange, and often like those of the citron, sometimes uniting the two. There are striped, there are long, there are quilled ones. Most of them have the winged petiole, like the orange leaf. The flowers bloom in spring and in autumn, having, like the leaves, divers forms. Some have petals, white inside, while the outside is shaded with red, and set themselves as citrons. Others, nearly white, with corolla much larger and more pronounced, produce mixed fruit, while still others have a perfectly white corolla, producing nothing but bigarades. Some have no pistil, and drop off.

The fruit follows the caprice of the rest of the tree. One sees sometimes a bigarade in form of a lemon; others are mingled lemon and orange, at times round, sometimes having a nipple at the summit. Others have skin of an orange and pulp of a citron. These trees bear also citrons of many forms, of which some unite the cit-

ron and the orange, and, finally, there are fruits of which the outside and inside show four parts crossed, of which two are citron and two are orange, while by the side of these are oranges perfectly formed, without the least mixture. It is necessary to say that the orange is always a sour fruit, and that the citron is the citron of Florence.

The bizzarrie was at first multiplied by means of the graft. It has been remarked that the buds, of which it was difficult to distinguish the nature, developed often only simple oranges or citrons.

There is another caprice of this tree still more singular—that of a citron coming from a bud which grew at the axil of an orange leaf, and conversely the orange from a bud of which the leaf is citron. This phenomenon deceived so often the gardeners, who obtained from their graft a simple orange or citron, that recourse was had to layers, and only thus can this beautiful tree, with all its caprices, be multiplied.

It is cultivated only among amateurs, and is common in Tuscany; but I have seen it in Genoa only in the garden of M. Durazzo.

ART. IV.—Of the Sweet-fruited Orange.

Citrus aurantium Sinense flore icosandrio, corolla alba, folio petiolo alato, fructu globoso aereo, medulla dulci.

SYNONYMS OF SWEET ORANGE.

Oranger a fruit doux; Orange douce.
Auranco domestico; Arancia dolce.
Aranci; Citroni. (Matiol.)
Aranzi. (Giustin. Hist. of Genoa.)
Melangolo; Melarancia. (Font.)
Naranzi. (Mang.)
Narendj helu. (Forskal Flor. Egypt. Arab.)
Aurantium succo dulci. (Salm.)
Aurea malus fructu dulci.
Aurantium fructu dulci. (Vole.)
Aurantium vulgare medulla dulci. (Ferr.)
Arancio dolce; Auranco di Portogallo; Auranco di Malta; Melarancio; Arancia da mangiare. (Targ.)
Citrus aurantium. (Lin.)

The orange of sweet fruit presents a large number of well-marked varieties, and but few sub-varieties. Among the varieties are two which bear the characteristics of the type. First is the common sweet orange, or Portugal; second is the China orange.

It is useless to endeavor to ascertain whether Nature created originally the first, of which the fruit has a little thicker skin, or whether it is a variety of the second; therefore, we will take one for type, and this will be the *aurantium vulgare*; and we will place the *aurantium sinense* at the head of varieties, of which there are eight.

First. The type, or Portugal orange.

Second. The China orange.

Third. The red-fruited orange.

Fourth. The dwarf, sweet-fruited orange.

Fifth. The olive-shaped orange.

Sixth. The double-flowered orange.

Seventh. The sweet orange, with edible skin.

Eighth. The pompelous.

The hybrids are very numerous. We have put two among the bigarades, as that species dominates in their characters. Two others have been ranked among citrons, and three among lemons.

We shall give to the list of oranges but three hybrids, in which the traits of the orange are conspicuous:

First. Is the sour lime, with orange flowers.

Second. The variegated lime, or orange with white fruit.

Third. The striped lime, or Turkish orange, with variegated leaves.

I have seen many sub-varieties which are connected to these hybrids, but I consider it useless to describe all these sub-divisions, whose additional characteristics furnish nothing new.

Any person adopting the principles of my theory could class them for himself on occasion, and connect them to the variety to which they belong.

Neither have I thought it my duty to place in this arrangement a great number of other singular races, of which one finds the names in modern works, without their characteristics being there determined. They do not exist in the gardens of Italy and Provence, nor in those of Spain, where I have sought for them in vain. I have come to believe them but imaginary varieties, or else species of India, not known in Europe. Some botanists have also founded species upon the presence or absence of the thorn (*Citrus inermis*).

I have already remarked that this part, so natural to the orange, is sometimes lacking in individuals produced by an extraordinary fecundation.

This phenomenon, analogous to that of the scarcity of hair, which distinguishes sterile beings in the animal kingdom, forms one of the traits accompanying often the choicest varieties; but it does not of itself constitute a variety.

It is because of these reflections that the thornless orange has not been placed in this table.

VARIETIES—NO. XXX.

Citrus aurantium Sinense fructu globoso, cortice crasso, medulla dulci, vulgo Portugal.

Oranger a fruit doux or de Portugal.

Arancio dolce: Portogallo.

Aurantium vulgare medulla dulci.

Aurantium vulgare fructu dulci: Aranzo dolce. (Vole., p. 187.)

Aurantium Olysiponense: Appel Sina of Lisbonse. Oranje appel. (J. Commelin.)

Arancio di Portogallo.

Citrus aurantium Olysiponense: Oranger de Portugal. (Desf.)

The orange of Portugal, or common sweet orange, is a tree growing to a great height when raised from seed. Its leaf is green, having a winged petiole, its shoots are whitish, its flowers entirely white and very odorous, though not equal in perfume to those of the bigarade.

Its fruit, ordinarily round, is sometimes flattened, sometimes a little oblong. The rind, less than an eighth of an inch in thickness, is of a reddish yellow, and full of aroma; the inner skin is a sallow white, spongy and light. The sections, nine to eleven in number, contain a sweet juice, very refreshing and agreeable; its seeds are white and oblong, germinating very easily and reproducing usually the species with little change. There is a variety with no thorns; it is the race cultivated mostly by grafting, and is seen in all countries where this method of propagation is followed. In places where the orange is grown from seed, it is rare to find it deprived of thorns.

VARIETIES—NO. XXXI.

Citrus aurantium Sinense fructu globoso, cortice tenuisimo, lactido, glabro, medulla suavissima.

Oranger de la Chine.

Arancio fuo della China.

Aurantium Olysiponense sive Sinense.

Aurantium Olysiponense: Appel Sina of Lisbonse.

Oranje appel.

Aurantium Sinense: Aranzo da Sina.

Poma da Sina. (Vole., p. 193.)

The China orange is a variety excelling all others in the perfection of its fruit, of which the juice is the sweetest, the most abundant, and the most perfumed. The skin is always smooth, glossy, and so thin that one can scarce detach it from the pulp. This is characteristic of this variety.

The orange of China grows from seed, as does that of Portugal, and I have in my garden many individuals of it which have grown from seeds of ordinary orange. It has, commonly, a thorn by the side of the bud, but there are those from seed which lack this part.

Rumphius reports under the name of *aurantium sinense*, or, *lemon manisjina*, a species of sweet orange, at Amboyna, which seems to be the same as this. He says that that tree grows higher and more rounded at top than the sour orange, a difference which also distinguishes them among us; that its leaf, furnished with a thorn, is long and winged; that its fruit, round and large, is of a blackish-green color, and its juice is sweet and vinous.

He adds that there is a second variety with fruit smaller and less sweet, and a third, of which the tree grows extremely high, and has flowers and fruit larger than ordinary oranges.

An examination of their nature would be necessary in order to decide whether they belong to our European varieties.

VARIETIES—NO. XXXII.

Citrus aurantium Hierochuntleum fructu sanguineo.

Oranger a fruit rouge.

Arancio sanguigno.

Aurantium Philippinum fructu medio, medulla dulci purpurea. (Fer., p. 430.)

Orange rouge de Portugal: Orange grenade.

Orange de Malte. (Nonv. Dict. d'Hist. Nat.)

The red-fruited orange is a singular variety. Its appearance, its leaf, its flower, are all exactly like the common orange. Its fruit alone is distinguished by a color of blood, which develops itself gradually, and like flakes. When the fruit begins to ripen it is like other oranges; little by little spots of blood-color appear in its pulp; as it advances to maturity these enlarge, becoming deeper, and finally embrace all the pulp and spread to the skin, which is, however, but rarely covered by the peculiar color; yet this sometimes occurs, if oranges are left upon the trees after the month of May.

This orange is multiplied only by grafts, having few seeds, and those of little value. This is a proof that it is a monster; if it were the type of a species it would yield more seed and reproduce itself by seed. Its branches are without thorns, its fruit is sweet, but less so than the China oranges, and it has thicker skin.

It is cultivated largely in Malta and in Provence. In Liguria it is found chiefly among amateurs and seedsmen.

I would here remark that the greater number of botanists, in describing the India oranges, speak often of varieties which are distinguished by a vinous pulp: *Medulla vinosa*, (Rumph.) *Cum parva vinositate*, (Lb.) *Medulla vinosa saporis*, (Kæmpf.) It appears very probable that they have intended

to express by the word *vinosa* (wine-like) the blood-color which distinguishes our red orange. If this be so, our orange is of Indian origin evidently, and may well be a hybrid of the *Citrus aurantium vulgare*, and some one of the species of India.

VARIETIES—NO. XXXIII.

Citrus aurantium Sinense pumilum fructu dulci.
 Oranger nain a fruit doux.
 Arancio naino dolce.
 Aranzo naino dolce. (Vole.)
Aurantium humile pumilum foliis ovatis, floribus sessilibus. (Millar.)

The sweet-fruited dwarf orange was still, at the middle of the seventeenth century, confined to China. Ferraris says that it was not cultivated at the Philippines, and that the Chinese carried large quantities to Manila. It is to be supposed that since then it has been naturalized in Europe. I have found it in the Hesperides of Volcamerius, and it appears that it is reported by Millar in his dictionary, where he gives two varieties of dwarf orange, only one of which is called a sour fruit.

It is unknown in Liguria and Provence.

VARIETIES—NO. XXXIV.

Citrus aurantium Sinense fructu oliviforme, dulci medulla et cortice.
 Oranger a fruit oliviforme, a ecorce et jus doux.
 Arancio a scorza dolce oliviforme.
Aurantium Sinense fructu olive, etc.

The dwarf, olive-shaped orange is still peculiar to China. Ferraris says of it, that it was unknown in his time, except in that country, and I do not know that it has been naturalized in Europe since then. I have not found it in any botanical work. Its fruit is shaped like, and no larger than, a Spanish olive; the juice is very sugary, and the skin sweet.

VARIETIES—NO. XXXV.

Citrus aurantium Sinense flore semipieno, fructu sepe testifero, medulla dulci.
 Oranger a fleur double et semi-double, souvent portant un fruit dans l'autre, a jus doux.
 Arancio a fior doppio.
Aurantium flore pleno. (Vole.)
 Oranger a fleur double. (Calvel.)

The double-flowered orange is distinguished only by a multiplicity of petals, increasing the size of the flower at the expense of the sexual parts, which are lacking.

I have never seen one of entirely double flowers. The one I own has semi-double.

I have before remarked that this variety often gives fruit which encloses a second within itself, and that this is frequent in all these monstrous varieties and in hybrids.

VARIETIES—NO. XXXVI.

Citrus aurantium Sinense fructu dulci, cortici eduli.
 Oranger a fruit doux et a ecorce douce.
Aurantium Lusitanicum pulpa, cum cortici manducanda et dulci. (Vole.)
 Aurantium Philippinum sapore dulci, cortice flavo eduli. (Fer.)
 Malus aurantia cortici eduli. (Spanish.) Naranja caxel. (Cins.)
 Aurantium dulci cortici. Oranje appel met Zoete Schil. (Commelyn.)

The orange of edible skin is unknown in Liguria. It came, originally, from the Philippines, and I have seen it at Seville. The fruit is sweet, and its skin has, at maturity, less of piquance than that of our oranges.

I have observed, however, that we also have varieties with thick skin, which acquire a cer-

tain sweetness when the fruit remains on the trees until August. The orange of edible skin does not merit cultivation, except for completing collections.

VARIETIES—NO. XXXVII.

Citrus aurantium decumanum fructu omnium maximo, medulla dulci.
 Oranger Pompelemus.
 Arancio massino.
 Pampelmus. (Meister.) Idm. (84 Linn.)
 Malus aurantia utriusque Indię fructu omnium maximo et suavissimo, Belgis orientalibus Pompelemus.
 Virginicensis nostratibus ab inventoris nomine, qui ex India orient, ad oras Americanas primus transtulit.
 Shaddock. (Pluken. Almag. p. 239.)
 (Sloane Voy. to Jamaica, p. 41, tab. 12.)
 Lino decumanus; Pompelemos. (Rumph.)
 Aurantium Indicum maximum, vulgo Pompelemos. (Vole.)
 Aurantium fructu maximo India orient. (Beerrh.)
 Called Chadoek, or la Tete d' Enfant, or Pampelmouse. (Millar Dict.)

The *Citrus decumana* has been often confounded with the *ponum Adami*, both varieties being of an extraordinary size, consequently the name *decumana* or *decumanus*, which signifies ten times greater (derived from *decem*), has been applied indiscriminately to both. They present, however, traits so different that it is necessary to put the first among varieties, the second among hybrids.

The *aurantium decumanum* is the same as the *lino decumanus* of Rumphius, and the *malus aurantia fructu omnium maximo et suavissimo* of Sloane, and is a veritable orange tree, bearing extraordinarily large fruit, yet having all the characteristics of the orange.

In India this variety gives a numerous gradation of sub-varieties, described principally by Rumphius in his *herbarium amboinense*, and of which some are perhaps hybrids crossed with bigarades, citrons, and lemons.

This writer describes some having red and sweet fruit; others with fruit sour and skin edible; still others with insipid fruit and bitter skin.

Sloane confounds also this orange with the Adam's apple, and after having reported it as the *malus aurantia fructu rotundo maximo patlescente humanum caput excedente* of many botanists, he calls it the *malus aurantia utriusque Indię, fructu omnium maximo et suavissimo* of Pluken, which is the true pompelemus.

Linnaeus, who wrote after these, united them under the same name, and appeared to indicate the Adam's apple in the *malus aurantia fructu * * * * * maximo* of Sloane, and the pompelemus in that of Meist.

All this clearly proves the existence of a sweet orange, extraordinarily large, whose hybrids and varieties are so numerous that they cause confusion in names.

This orange is not connected with the *aurantium maximum* of Ferraris, which appears to be a hybrid of two oranges, and which has traits peculiarly its own.

I do not know whether this tree is cultivated in Europe. I have many times visited gardens in Italy and Spain, where they pretended to have it, but have always found it was not the Adam's apple. I have, however, seen one of its fruits brought from America, and preserved in spirits of wine, at the Museum of the Botanical Garden, Paris. Its size is truly extraordinary. I have never seen an Adam's apple approaching it in

volume. Its outer skin is smooth, and of the color of the orange, which it exactly resembles in form.

I do not know the nature of its inner skin and pulp, but the descriptions of Rumphius and others teach us that there exist several varieties, some having sour and some sweet fruit. I have a fancy that the fruit at the Museum belongs to these last; for the sour fruit is said to be a pale yellow, the color of the Pomme d'Adam—very far removed from the beautiful, golden fruit at the Museum.

Millar says that this orange was carried from India by a Captain Shaddock.

There is a certainty respecting the origin of the Adam's apple, though the history of the pampelmous is obscure. We know that the first, resembling the pampelmous in size, and attached to it by many varieties, has been cultivated in Europe for more than 500 years. It is possible that the English isles received it from Asia, but it is certain that the Spaniards, who acclimated it upon the continent, brought it from Spain, where it was cultivated from the time of the Arabs.

HYBRIDS—NO. XXXVIII.

Citrus aurantium Sinense limoniforme folio petiolo alato, fructu flavo oblongo papilla carente, cortice crasso, medulla amara.

Lime a fleur d' orange.

Aranzo a frutto limoniform, vulgo Limia.

Aurantium limonis effigie.

Aranzo limonato. (Vole.)

The lemon-shaped orange is a true lime. It is known, however, by the name of *limia*. The fruit has the shape of a lemon, and juice of a bigarade; the leaves and flowers are also like the latter. It is a hybrid of these two species. They cultivate it but little in Liguria. I have a specimen which I keep to complete my collection.

The juice may be used like that of the lemon.

HYBRIDS—NO. XXXIX.

Citrus aurantium Sinense folio et fructu variegato.

Oranger a fruit blanc : Oranger panache.

Aranco bianco.

Aurantium strilis aureis distinctum : Aranzo fiamato.

(Vole., p. 195.)

Bonte orange appel. (Commel.)

Aurantium virgatum. (Fer.)

Oranger Suisse or Rega.

Oranger a feuille et fruit tranche de blanc. (Encycl.)

The orange with variegated fruit is a hybrid of the lemon. Its leaf is edged with a yellowish white border, which is due to the mixture of this species. Its fruit, before maturity, is whitish, striped by some greenish lines, which become yellow as the fruit ripens; while the white ground changes to orange-color. Its pulp is sweetish and has little perfume.

This variety is cultivated in Liguria only by collectors and seedsmen. It is very ornamental in gardens, but grows slowly, and gives but little fruit. The seedsmen of Nervi carry it to Paris, where I have seen some very good roots.

VARIETIES—NO. XL.

Citrus aurantium Turcicum folio angusto maculato, fructu oblongo, cute albidia strilis variata virentibus, evanescens in maturitate, cortici crasso, medulla amara.

The striped orange is a sub-variety of the Turkish orange, with willow leaves, and has a similar appearance.

Its leaf is a little shorter and straight, and is a little more irregularly edged, with a whitish yellow border.

The fruit is yellowish, and striped with many greenish bands which cut it in its length. The pulp is bitter and juice insipid. I consider it a hybrid of the lemon, for it appears to have received from it the yellow with which it is striped.

It is cultivated in Liguria by amateurs and seedsmen.

ART. V.—Of Monstrous Fruits.

No genus of plants is so much disposed to yield monsters as the *Citrus*. These are of two kinds, monstrous races and monstrous fruits.

We have seen that monstrous races are due only to an extraordinary fertilization modifying within the ovary the germs that give them birth.

We have observed that the monstrous fruits appeared also to be produced by the action of a forced fertilization, which caused a modification in the forms of the ovary.

The first fact appears carried to the last point of evidence. It establishes the influence of the pollen upon the organization of germs, without, however, destroying the pre-existence of these embryos in the ovary.

The second fact is not so well established, but the consequences of it are much more important. So that whoever succeeds in confirming it by exact and repeated experiments will have fixed a principle of vegetable physiology now uncertain; and which has been judged until the present time, by a system of analogy, with the animal kingdom. He will have determined the measure of co-operation which the male principle has in reproduction.

The fact of monstrous races can be reconciled with the pre-existence of the germ in the ovary; for this germ, receiving life but by the agency of the fertilizing part, may, by this operation, be altered in the principles of its organization, and give but vegetable mules.

But the fact of monstrous fruits would appear to destroy the theory of this pre-existence. Here the pollen changes the form and nature of the ovary, and multiplies the embryos in this envelope in a singular manner, such as the *aurantium fatiferum*, the *corniculatum*, the *digitatum*, and the orange that I have obtained with a lemon border.

The *aurantium fatiferum* presents a superfoetation, an imperfect development of many germs enclosed one within another, or united under the envelope of an exterior germ. These germs—did they exist in this ovary, or have they been formed there by the pollen which has fertilized it? This is the problem which remains to be solved.

On the one hand I observe that these monstrous developments have place, very often, in flowers of which the fertilization has been forced by a superabundance and mixture of pollen. On the other I see that this phenomenon is very frequent in the monstrous races, such as plants with double flowers, and appears to show modifications in the germ analogous to those which produce the change of sexual parts into petals.

These two observations may be the base of

two conjectures, which it will not be impossible to reconcile; but my sixth experiment would appear to show results having a wider base, and in contradiction to the received system. In this experiment (spoken of in an early part of this work) I have obtained a change in the nature of the ovary of an orange flower by means of the forced and multiplied action of the pollen of a lemon. This result seemed to indicate that the masculine element did something more than giving motion to the embryo, and the vitality necessary to its development. It would teach also that these principles acted together by their mingling or combination in forming the fruit which resulted from the experiment in question. I dare not enter upon the discussion of this delicate problem. I limit myself for the present to an account of observations made by myself in this matter, and I desire that physiologists better qualified would examine them, following the experiments which I have but begun, with the patience, care, and exactness that they seem to demand.

ART. VI.—Of the *Agrumi* of India—Observations upon these Plants—Their description and synonymy.

The description which we are about to write is doubtless sufficient for cultivators, but will be considered imperfect for botanists.

The *Citrus* of Europe is, perhaps, the single, isolated genus of which all the species are known to us; but, for some time, it has been confounded with analogous genera belonging, without doubt, to the same family with ours, yet, in my opinion, forming special branches of it; it is therefore necessary to take cognizance of all those individuals.

India produces a great number of plants bearing close analogy to our *Agrumi*, chiefly in respect to the form and acidity of their fruit. Their characteristics vary to infinity, extending gradually to species which belong, without doubt, to very different genera. Yet the likeness which they have preserved to our *agrumi*, appears to have formed, chiefly among the natives, a point of comparison, and they have added, nearly everywhere, to their particular and distinctive names the generic names of *lemon* or *naregam*. Thus they call at Amboyna (one of the Moluccas) the *bilacus taurinus* of Rumphius, *lemon gela*; as at Malabar, one knows under the names of *ijeroa-katou-naregam*, of *katou-naregam*, and of *mal-naregam*, three plants called by Europeans *limon*, and classed by Linnæus in the genus *limonia*. All these species, however, form genera approaching our European species, and which might, perhaps, be united in the same family under the common name of *Agrumi*.

In general they resemble ours in the activity of uninterrupted vegetation, which shows at all times flowers and fruit in the midst of foliage always green; in a sharp aroma spread over all the parts of the plant; in the whiteness of the flower, which is odorless, and in the nature of the fruit, which is always a round berry (a *berry* among botanists is "a succulent, pulpy pericarp, containing naked seeds. The orange and lemon are berries with a thick coat." Lincoln's Bot.), hav-

ing a yellowish, aromatic skin, and containing a certain number of sections, and a juice sometimes sweet, sometimes bitter, and nearly always acidulated. But these plants usually grow only to the size of shrubs; their branches are crooked, knotty, and often mutilated; their leaves are frequently divided into two by the wings of the petiole, and are, at times, discolored; their thorns, sometimes double, often lacking, are frequently longer on the old branches than on the young, and arrange themselves, nearly always, in some peculiar way. Their flowers, now of four, now of five petals, are sometimes axillary and solitary, and very often terminal; and, in place of bouquets, like our orange blossoms, they show themselves in bunches like the olive. We know very little of their fructifying parts. Rumphius rarely describes them. The fruit is a berry, but this berry is now round, now oblong, at times angulate; it is often covered by tubercles of a fixed form, and disposed with a certain regularity. Its color, though at times green, usually resembles that of the lemon or orange; and its pulp, enclosed in numerous sections, is now sweet and vinous—now disagreeable and glutinous.

Finally, their traits, taken as a whole, announce decidedly that they do not belong, for the most part, to the genus *Citrus*.

There are among them, doubtless, several not far removed from, and having traits of, our hybrids, but there are also many presenting traits which place them nearer to some species of *eratera*, to the *limonia*, and other plants of India.

One may see in the *Citrus trifoliata*, in the *limon angulatus*, and in the *limonellus madurensis*, much to connect them with the *bilacus taurinus* of Rumphius, which, from its likeness to the lemon, is called at Amboyna *lemon gela*.

These appear to be links by which nature passes gradually from one genus to another, and forming what a great botanist has aptly called *familles par enchainement*.

We have not thought it possible to dispense with giving an idea of all these species. Beginning with those which seem to belong to our *agrumi*, and which might be varieties of them, we pass on to those decidedly removed by their traits, and shall finally say a word concerning species which touch them in analogous genera. We will designate them by the general name of *agrumi*.

NO. I.

Acumen nobilis Chinense.

Citrus nobilis. (Lour. Fl. Coc. Sp., 3.) A Camxsanh, B. Tsem can : Citrus inermis, ramis fascendentibus, petiolis strictis, fructu tuberculoso, sub-compresso, (t. 2, p. 166.)

The *Citrus nobilis*, rare in China, but abundant in Cochin China, is a tree of medium size, distinguishing itself particularly by the upward growth of its branches, which are thornless. Its leaves, scattering, lanceolated, quite sound and lustrous, are of a dark green, and have a strong odor. They have linear petioles. The flowers, arranged in terminal bunches, are white, having five petals and a very pleasant perfume. The fruit is a round berry, a little compressed; it usually has nine sections, red inside as well as out. The skin is thick, juicy, sweet, and covered by unequal tubercles (warts.)

This is twice as large as the Chinese orange, and is the most agreeable of all.

NO. II.

Acumen Margarita.

Citrus Margarita: Chin tsu a Chau tri: *Citrus rautis* a-cententibus, aculeatis, petiolis linearibus: bacis 5 locularibus, oblongis. (Lour. Fl. Coch. t. 2, p. 169.)

The *Citrus margarita* resembles a little the *Citrus japonica*, but it differs in many traits, which make it another species. It is a shrub whose branches are straight and thorny; its leaves, lanceolate and scattered, are based upon linear petioles; its odoriferous flowers having five white petals are joined in small numbers upon peduncles scattered along the branches.

Its fruit (small, oblong, and of a red-yellow) contains but five sections under a very thin skin; the pulp is sweet and agreeable.

It comes from China, above all from the neighborhood of Canton, and is never found in Cochinchina.

The *Citrus* of Thunberg, on the contrary, has a winged petiole, and the fruit has thick skin, containing nine cells.

NO. III.

Acumen Amboinicum caule anguloso, folio maximo, petiolo alato, flore magno, fructu spherico, compresso, foveolis notato, cortice croceo, medulla adherente, succo viscoso et acidulo.

Agrume rouge d'Amboine.

Aurantia alata, vulgo Lemoen Han. Rum. *Citrus fusca*. (Lour. Fl. Coc. Sp. 6.—a Cay Baong; Chi xac B chi ken.)

The red *agrume* of Amboyna, as well as other varieties of this island, and of Japan, offers characteristics which merit notice. We will copy what Rumphius says of it in his herbarium of Amboyna.

The sour-fruited orange is a tree growing at Amboyna to a very great height. Its stem is angular and as if furrowed; its winged leaf is nearly as large as that of the pumpelmoes, and has a very strong odor; the thorn is long and sharp; the flower, large and white, having five petals.

The fruit, round and a little flattened, is marked by many small spots, and does not take its color entirely until its full maturity. The skin adheres to the pulp, and the sections adhere among themselves as in the lemons. The pulp is full of a gelatinous and acidulated juice. This species resembles the *Citrus fusca* of Loureiro, of which it is perhaps but a variety.

NO. IV.

Acumen Sinense fructu ex viridi nigricanti, medulla subdulci.

Agrume de la Chine.

Agrume Chinesse.

Aurantium Sinense: *Lemon manis* Tsjina. (Rumph. Herb. Amb., part 3, cap. 41.)

The *aurantium sinense* which Rumphius saw in the islands of Amboyna and Banda, appears not to differ from our orange.

It forms a fine tree, which grows larger than the sour orange; its straight branches give to it a head, rounded and high; the leaf, long, smooth, with a twisted petiole, has a lateral thorn. The fruit, large and round, has a skin of a blackish green color, which does not adhere at all to the pulp; its juice is a little vinous and sweetish.

Rumphius observes that there is also a species of it whose fruit is smaller and much sweeter; and three others, of which the first makes a very large tree, and bears a large, sweet fruit; the second produces a fruit covered by tubercles, and of which the pulp is scarcely sweetish; and

the third, a low shrub, gives a small fruit, whose skin is very thin and agreeable. The first, that he calls *aurantium verrucosum*, *lemon manis* because, appears to belong to our oranges. The second, called at Banda *lemon pouleron*, seems to approach the *lemon centricosus*, of which we shall speak farther on.

The third, which he calls *aurantium pumilum* *madureuse malaice* *lemon suassi*, and *lemon colte*, seems related to the *Citrus japonica* of Thunberg.

NO. V.

Acumen Amboinicum caule fruticoso, folio petiolo lineari, flore axillari.

Agrume d'Amboine.

Agrume d'Amboina.

Malmu citrinum: *Lemon süssu*: *Limo mammosus*, etc. (Rumph.)

The *lemon süssu* offers many varieties differing a little in size and form of fruit, and these all appear to be related to the citron, but they differ from it in the flowers, which are axillary, and which grow beside the thorn, often singly, sometimes to the number of two or three, but never on a common peduncle. Its fruit is oblong, and forms a kind of cone: the uneven skin yellowish and insipid, encloses a whitish and acidulated pith.

Rumphius says that the citron tree, or *limo mammosus*, is not indigenous at Amboyna or at Banda; that he has never seen it grow to the size of a tree, but rather to a bush, and that it grows no taller in India.

He also remarks that wild lemons are found in Java, where they are thought to be indigenous, and which are called *lemon Java*; also, that all these Indian oranges have peculiar traits, making them differ from European *Citrus*.

This remark is strengthened by his descriptions, always telling us of new beings that we cannot associate with our *Citrus*.

NO. VI.

Acumen Amboinicum folio maculato, petiolo alato, flore racemoso et terminali, fructu flavo minutissimo, medulla acidissima, Amboini Aurarius dicto.

Agrume d'Amboine a feuilles panachees.

Agrume a folie machate.

Limonellus Aurarius: *Lemon Maas*.

The *limonellus aurarius* has the physiognomy of a lemon mixed with orange, but it has, also, peculiar traits.

Its stem is tall, its leaf, deeply colored and variegated, is upon a petiole, whose wings are very nearly as large as the leaf.

The fruit, the size of a musket-ball, is round, mamelone (nippled), yellowish, and is formed of a skin so thin that it seems rather a pellicle than a skin, and which has not the lemon aroma; the pulp is full of an acid juice.

The flowers are very small and terminal, growing at the end of the boughs, in bunches, like the olive.

I know nothing of the number, position, or peculiarities of the sexual system. Rumphius, to whom we are indebted for this description, says nothing of them.

This fruit is called at Amboyna *aurarius*, because goldsmiths use its juice for cleansing their work.

NO. VII.

Acumen Indicum folio maximo alato, flore minimo, quatripetalo albo, tuberculis obsito, medulla granulosa acidissima.

Agrume vedatree d'Amboine a fruit tuberculeux.

Agrume verdastro.
Limon ventricosus. Malaice lemon Purrut, aliis Lemon
 Papua, seu *Limo crispus*, ex forma *crisporum crinium*
Popoensium, aliis *Limon tay Ayam*. Ternatensibus.
 (Rumph. Herb. Amb., c. 37.)

The greenish agrume, called by Rumphius *limon ventricosus*, has characteristics peculiarly its own, making it to differ essentially from our agrumi. Its leaf seems as though cut in the middle, it has so large a wing. Its flower, extremely small, has but four petals, and grows only at the very end of the bough, in form of a bunch of grapes.

The fruit is nearly green, just a little shaded with yellow; its skin, which is odorous, is covered at regular intervals by small buttons, all of one shape and size. Its pulp is granulous, green, and very sour. There is nothing said of its sexual system. We may connect to this species the *limon tuberosus*, the *lemon curamus*, the *lemon agrestis* or *papeda*, the *limo ferus* or *swangi*, that Rumphius found at Amboyna, and which have very nearly the same characteristics.

NO. VIII.

Acrumen Japonicum caule angulato, flore axillari, fructu minutissimo, pulpa dulci et eduli.

Agrume nan du Japon.

Agrume nano del Giappone.

Citrus Japonica. (Windeln. in Spec. Plant.)

Citrus petiolis alatis, foliis acutis, caule fruticoso. (Thunb. Jap., 292.)

Kin kan. (Kempf. Amer., 801.)

The dwarf agrume of Japan has been considered by Windelnow as a species of *Citrus*, but the description of it by Thunberg in his *Flora Japonica*, presents traits making it to differ from European oranges.

The most marked and at the same time most singular points of difference, are the angulous stem and axillary flowers. These traits would seem to place it near the lemons of Amboyna which so closely resemble the *limonia* and the *bilacus*. Thunberg also says that the *Citrus japonica*, which, in the parts of fructification, offers the same traits as the European *Citrus*, differs notwithstanding, in its shrub-like form which it always takes, in the smallness of its fruit, and in many other ways. He adds that it can scarcely be ranked in the class of oranges, its flowers being axillary, solitary, or binate, and never in bouquets; that it is like the lemon in axillary thorns, yet differs from it by the winged petiole, and by the fruit, which has the shape and color of an orange.

The *Citrus japonica* is, perhaps, the same as the *aurantium pumilio madurense*, or the *lemon massi*, and *lemon colte*, that Rumphius calls *species limonum fructu dulci omnium minima cortice tenui nec amaro*. * * * It has also some likeness to the *Citrus margarita* of Loureiro.

It would be necessary, however, to examine them in Nature, in order to see all their affinities.

VARIETIES NO. IX.

Acrumen Indicum madurense, caule pumilo et angulato, fructu minimo, cortice tenuissimo, medulla acida.

Agrume orange de Madure a tige anguleuse.

Agrume aranciato di Madura.

Limonellus Madurensis: Lemon Madura. (Rumph.)

Citrus Madurensis; a k n kult B k n; kult xu; *Citrus inermis* ramis diffusis, angulatis, petiolis linearibus, fructu globoso levi. (Lour. Fl. Coch. t. 2, p. 497.)

The agrume of Madura is an extraordinary bush, appearing to hold to the *Citrus* and the *bilacus*. Perhaps it is one of the links attaching

these two genera, or it may be a product of their mingling. The stem is not more than two feet high; the branches, having no thorn, are angulous, crowded, and striped; the simple and solitary leaf is but an inch in length. Its fruit is a slightly flattened spheroid, always green, and the size of a bullet. It is covered by a thin skin, like a pellicle.

This trait it has in common with many other species, especially the *limonellus aurarius*. Enclosed within this skin are numerous sections, containing an aromatic, sourish pulp, and one seed, always small and always solitary.

Rumphius says nothing of its organs of reproduction.

Loureiro, who gives a description of it under the name of *Citrus madurense*, or *Citrus inermis*, *ramis diffusis, angulatis, petiolis linearibus, fructu globoso levi*, says its flowers are white, five-petalled, small, and odorous, and united in small number upon one peduncle or footstalk. He says nothing of the number or position of its stamens; but as he places this in the genus *Citrus*, we may presume that it is also of the class Polyadelphia, order Icosandria.

VARIETIES—NO. X.

Acrumen Indicum caule spinoso, pumilo, ramis in aculeo, desinentibus, folio alato, flore axillari, solitario, albo et odoroso, fructu minimo acutissime papillato, cortice flavo tenuissimo, odore jucundo, carne alba succosa et grate acida.

Agrume Nipis.

Limonellus: Lemon Nipis. (Rumph.)

The agrume nipis appears to represent both the orange and the lemon, yet differs by many traits wholly its own.

Its stem is very small, its branches end in a sharp point like a thorn, its leaf is winged. The flowers, axillary and solitary, are entirely white and odorous. The fruit, yellowish like a lemon, has the size and shape of an apricot, but is terminated by a nipple very much elongated, and singularly pointed; its skin, which is very thin, has a pleasant odor, and covers a white pulp full of acid juice.

John Burman, in his *Thesaurus Zeylanicus*, regards the *limon nipis* as the same plant as the *limonia malus sylvestris zeylanica fructu pumilo*, of Ceylon. He writes as synonymous the *malus aurantia fructu limonis pusillo acidissimo*, of Sloane, and the *catu-isieri naregam* of Malabar, of Reede; which is the *limonia acidissima* of Linnaeus.

Nicholas Burman, in the *Flora indica* (which he arranged according to the system of Linnaeus), in connecting to the citron lemon the *limonia malus sylvestris zeylanica*, of the *Thesaurus zeylanicus* of Burman, regards it also as one with the lemons of Amboyna, of Rumphius, (*limonellus cum varietatibus*. Rumph.)

It is easy to see by examining the descriptions and figures of these plants that they differ too much among themselves to be considered a single species. They really have some analogy connecting them, but even these likenesses cannot make them rank in the same genus.

NO. XI.

Acrumen Ambojense fructu anguloso, spina bina stipulari.

Agrume anguleux.

Agrume anguloso.

Citrus angulata: *Citrus petiolis nudis, foliis ovatis acutis, fructibus angulosis*. (Widenow.)

Limonellus angulosus, malaice.
Lemon utan Basagi. (Rumph.)

The angulous agrume is still farther removed from the European Citrus, and appears to connect this genus with the *limonia* by the *bilacus taurinus* of Rumphius.

Its stem is not larger than one's arm; its branches are crooked and knotty; the leaf, resting upon a simple petiole, grows between two thorns, which form a sharp angle at the point where the bud appears, and the next leaf grows solitary by the side of the bud, with no trace of a thorn; this arrangement, in the old branches, alternates in such a way as to make a leaf without thorn succeed a leaf with two thorns, even to the last shoot, while the young and new branches bear solitary leaves, the double thorn developing only in old age, as already spoken of. The flowers are solitary and white, resembling those of the *limon nipis*, but are smaller, and have five petals. We know nothing of its fertilizing organs.

The fruit is very small, and sometimes four, at times five-angled, and flattened upon the sides; of a greenish color while young, but occasionally growing yellow at maturity. A very thin skin encloses sections full of a glutinous juice, with odor like the *limon nipis*, but not edible. It contains four or five seeds.

Rumphius adds that this bush, found lately in the marshy woods of Mangée (India), near the sea, is almost unknown to the natives, and that it grows in the salt water which covers the soil at high tide.

It is easy to see the connection between the *limonellus angulosus* and the *bilacus taurinus*.

VARIETIES—NO. XII.

Acerumen Japonicum foliis ternatis, fructu tetrice, pulpa glutinosa.

Agrume du Japon a feuilles ternées.

Agrume Japonico.

Citrus foliis ternatis. (Linn.)

Citrus trifolia: Oranger a feuilles ternées. (Desfont.)

The *Citrus trifoliata* was the first to take a place among our Agrumi. Linnæus regarded it as a species of the Citrus, and named it in his *Systema Plantarum*, *citrus foliis ternatis*.

Three authors have given us its description. Kaempfer first, then Thumberg, and finally Loureiro.

Kaempfer paints it as a fruit whose branches are twisted, and leaves ternate (like clover). The flowers, resembling those of the medlar tree, are axillary, solitary, and formed of five oval petals, terminated by a sort of guard like a long finger-nail, and enclosing twenty or twenty-five stamens, with free filaments surrounding a short and globulous pistil, which changes into a fruit looking like an orange, yet containing, within seven sections, a glutinous and disagreeable pulp.

Thumberg's description accords with that by Kaempfer, but he says nothing of the number and position of stamens. It appears, however, that he supposed them to be the same as in the *Citrus trifoliata* of Kaempfer, seeing that he ranges this that he describes in the class *Polyadelphia*, order *Icosandria*.

Loureiro reports as *Citrus trifoliata*, a plant resembling that of Kaempfer and Thumberg in many traits, yet of which the flower is totally different, and he, in consequence, makes it a separate genus, which he classes in the *Pentandria*

Monogynia, under the name of *triphasia aurantiola*.

This discord, which does not escape his observation, leads him to think either that botanists preceding him have not closely observed, or that their *Citrus trifoliata* is a plant of different species from that which he is describing. I should think, with regard to the first opinion, that if Kaempfer's description were less detailed, one might suppose this author had not carefully observed this flower, to which, in his time, very little importance was attached; but the description is so precise, and agrees so well with the accompanying drawing, that we must believe his *Citrus trifoliata*, a different species from the *triphasia aurantiola* of Loureiro.

This belongs, doubtless, in the artificial system of Linnæus, to a different class, but in the natural system it ought to be connected to the same family, and should make a link of the great chain forming the family of Agrumi.

It is to be desired that individuals of all these species should be brought to Europe, for it is only by a thorough and careful examination of their characteristics that one can judge of their proper places in the natural system.

It is pretended that the *Citrus trifoliata* has already been cultivated in the orangery of the Botanical Garden at Paris, but one must believe it has also perished there, for I have sought for it in vain. They have shown me only a *limonia trifoliata*, which, as it has never blossomed, cannot be thoroughly known. We must then wait until enlightened botanists can observe them in their native countries with more attention.

CHAPTER IV.

HISTORY OF THE CITRUS.

ART. I.—*Studies upon the citron tree—Indigenous in Media—Naturalized in Palestine, Greece, and Italy—Date of its transmigration.*

Centuries roll on before man gathers upon one soil the many plants scattered over the surface of the globe. He can for a long time content himself with the productions which Nature may have given abundantly in his own country; but, as civilization extends his needs, his knowledge and connections, he lays all climates under contribution to enrich his native soil, of which he multiplies the resources and means by a laborious industry.

It is thus that we see the fruits of Asia growing beside those of Europe and of Africa, and new trees, taken from distant regions, succeed to plants less useful. The citron, lemon, and orange trees are the last among exotic productions which have contributed to the embellishment of our gardens. Placed by Nature in various climates, they have become known to Europeans at different epochs, and as the result of very dissimilar events.

It seems that the citron first appeared. Indigenous in Media, it was soon propagated in many parts of Persia, where the Hebrews and the Greeks could easily learn of it. It is not possible, however, to fix the precise date when these two nations began its cultivation, nor by what steps this culture penetrated to the European

countries. As soon as the Hebrews were established in the Land of Promise, they began to have intercourse with the Assyrians and Persians, and it is reasonable to suppose that they would be the first to know of this beautiful plant, and to naturalize it in the fertile valleys of Palestine.

It is, however, astonishing that in all the Bible one meets not a single passage where this tree is mentioned.

I have thought, sometimes, with a crowd of interpreters and commentators upon this book, that the tree *hadar*, whose fruit the Hebrews carried at their Feast of Tabernacles, was no other than the citron tree.

That which gives probability to this opinion is the custom always maintained among the Jews, of presenting themselves in the synagogue on the day of tabernacles with a citron in hand. This usage, existing still to-day among them, and to which they attach great importance, dates, without doubt, from an epoch very remote, since there is mention of it in the Jewish antiquities of Josephus; and Samaritan medals have been found expressing on one side the *loulave* of the Jews, and upon the reverse of which one sees citrons fastened to a palm tree.

All these data, however, do not prove that the tree *hadar* is the citron—it is necessary to examine the words in Leviticus and those of Josephus to discover what gave rise to this opinion. "You shall take," said Moses to his people, "You shall take, on the first day, fruits of the tree *hadar*, of palm branches, boughs of the thickest trees, and willows that cross the length of rapid waters, and rejoice before the Lord your God." (Levit., c. 23, 40.)

If this custom had not been consecrated since so many centuries in the religious rites of the Jews, no person could have supposed that Moses wished to speak of the citron under the name of *hadar*. This word, very far from being the proper name of a thing, signifies, according to the *Seventy*, only the fruit of the finest tree, and, according to our Latin version, *fructus ligni speciosi*.

Now, according to the acception given to this word, *hadar*, the command of Moses enjoined upon the people only a choice of the fruit of the finest tree, without determining the species to be preferred. They were masters of the choice, and there is little doubt that as soon as they knew the citron they would substitute it for the tree of which they had made use until then.

The precept was generic—it would always refer to the most beautiful tree of which they had knowledge; and the citron was, without doubt, for a long time, and is, perhaps, still the finest tree known.

The words of Josephus come to the help of my argument. This historian does not say that the law directed the Hebrews to carry in the Feast of Tabernacles fruits of the citron tree; he only says that the law prescribed to offer burnt-offerings, and to render to God thanksgivings, by carrying in their hands myrtle and willow, with palm boughs to which Persian apples had been fastened. (*Pommes de Perse*.)

This expression shows that the apples had been attached to the palm tree by a sort of voluntary usage, and not in consequence of the precept.

The citron tree, then, was still unknown in

Palestine in the time of Moses. At that period the Asiatics were not sufficiently civilized to think of transporting the plants of one country to another; neither their wants nor their habits of luxury had, as yet, made close ties between nations. But it is surprising that the Jews did not know of this tree after the Babylonish captivity; and we are still more astonished to find that they knew nothing of it at the commencement of the Christian era.

The *Seventy*, who translated the Scriptures into Greek two hundred and sixty-six years after the return of the Hebrews to Palestine, rendered the word *hadar* by the same paraphrase used in the Latin version—"the fruit of the finest tree." And the gospel, which contains so many allusions to the palm, the fig, and many other trees, says not a word of the citron.

This tree, however, was already known to the Greeks and Romans. Theophrastus gives a very truthful and exact description of it. This philosopher wrote after the death of Alexander, whose conquests had greatly extended the knowledge of the Greeks concerning the region of Asia, situated this side the Indus, where this plant was indigenous. These are his words on the matter:

"All the country situated east and south of us produces peculiar plants and animals. Thus one sees in Media and Persia, among many other productions, the tree called Persian or Median apple. This tree has a leaf as large as and resembling the *pourpier*; it has thorns like those of the pear tree and hawthorn, but which are more slender, pointed, and stubborn. Its fruit is not edible, but it has an exquisite odor, as also have the leaves, which are used as a protection from moths in clothing. A decoction of the pulp of this fruit is thought to be an antidote to poison, and will also sweeten the breath.

"They sow the seeds in the spring in furrows carefully prepared, and water it for four or five days after.

"When the small plant has gotten a little strength, it is transplanted, always in the spring, into a moist and mellow soil, not too light.

"The citron bears fruit continuously; while some fruit is falling with ripeness other fruit is but just starting, and still other approaching maturity. Fruit is given only by the flowers which have in the middle a sort of straight spindle; those which do not have this fall off, producing nothing. They seed it also, as the palm, in perforated earthen vases. This tree, as we have said, is common in Persia and in Media."

Virgil is the first among Latin writers to speak of the citron, not, however, calling it by this name, but, like Theophrastus, giving it the appellation of Median apple.

He says it is a large tree resembling the laurel, whose leaves are odoriferous and never fall, whose flower sets easily, and whose precious fruit, though its juice is sour and bitter, serves among the Medes as a cure for poison, and is also used to correct a fetid breath, and as a relief to asthmatic old men.

Pliny begins to give it several names; he calls it *malus medica*, *malus assyria*, and *citrus*. He says its leaf, which carries a thorn at its side, and is of an excellent odor, is used by the Medes to perfume clothes; that its branches are always covered with fruit; some green, others scarcely

developed, others quite ripe; but that no one eats it, and that it is only used to protect clothing from moths. He says the Parthians eat the seed for perfuming the mouth, and adds, it is the only plant boasted of in Media; and vain attempts had been made to transport it thence to Italy. This description, which appears as if drawn from Theophrastus, would imply that the citron was, at that point of time, but a foreign production known only by name; but many other passages from Pliny teach us that this fruit had been carried from Persia to Rome, where it served in medicine, chiefly as an antidote to poison, and was in common use as a perfume for apparel, and protection from moths.

This naturalist reports that they found in the tomb of King Numa books of papyrus, which were uninjured, though entombed for five hundred and thirty-five years, and that the preservation was attributed to the virtue of the citron.

Such was the use of this fruit among the Romans for two centuries, and it was not until the time of Plutarch that they began to use it as food. We know not whether it was eaten raw, or made into confections with honey, which was so greatly used among the Romans.

Neither Plutarch, Athenus, or Apicius instruct us upon this point. The first two tell us that it was regarded as delicious food, but are silent respecting the manner of eating it; and Apicius, who devotes a chapter to it, in his Treatise on Cooking, contents himself by telling us in very few words the method of conserving it, without saying whether it was eaten, although he gives in another chapter a recipe for making a roscate wine with its leaves.

All these writers speak of it always as an exotic fruit, and not until a long time after was it naturalized in Italy.

We do not know whether the rigor of our climate, which, in olden time, was colder than now, retarded the naturalization of this beautiful tree, or whether we should attribute the delay to the difficulty of transporting it so far, in the centuries when communication was so difficult and the useful arts so little cultivated.

The first of these conjectures would seem the least likely, but finds in history more foundation than the second. Communication was, indeed, more difficult in those days, when navigation, then in its infancy, lacked the mariner's compass, and the manners and prejudices of the more isolated peoples raised barriers among themselves that civilization and philosophy have since overthrown. But we also know that the luxurious demands of the world's conquerors had penetrated to the most remote regions, and that nothing was spared which could augment the delights of the effeminate Cæsars.

Pliny tells us that attempts had been made to transport the citron in earthen vases, perforated to give air to the roots. This attempt, which the length of the voyage may have defeated, would have been more successful if, instead of plants, they had carried well-ripened fruit, of which they might have sowed the seeds. But we cannot suppose that the Romans, excelling as they did in agriculture, were ignorant or neglectful (if it had been practicable) of a means so simple and natural for placing in their gardens a fruit so precious. There must, then, have been a

greater obstacle to surmount, and this doubtless was the climate.

It would be easy to demonstrate by convincing arguments that many European countries have experienced in the revolution of centuries marked alterations in the temperature of their climate. The cultivation of the earth, the cutting of trees, and drying of marshes, would produce, naturally, this effect, but it is not necessary to recur to these physical discussions in order to establish a fact of which history gives us certain proof.

Virgil, in his Georgics, says that in his time it was necessary to cover the sheep in the Roman field in order to prevent their perishing in winter.

Pliny, the younger, in describing a field which he owned in Tuscany, said that the cold was so severe there that they could not cultivate the olive, the myrtle, or other delicate trees.

Horace asserts that the streets of Rome were full of ice and snow, and that in rigorous winters the rivers, and even the rapid waters, were covered by ice.

Juvenal pictures for us the superstitious female breaking the ice to make the ablutions (a religious ceremony).

Strabo reports that the vine made little growth in the parts of France bordering on the ocean; and that if it grew at all in such places it never bore fruit.

Finally, a vast number of passages to be found in old writings prove to us in an incontestable manner that the climate of Italy and France was, in those long past times, much colder than it is now. This was surely the obstacle which hindered the ancients from acclimating in Europe the citron, whose fruit was perfectly well known to the Romans, and was to them an article of luxury.

But its cultivation would extend into Asia Minor. The citron tree, originally from Media, where the warm, damp climate favored its continual vegetation, was already cultivated in Persia in the time of Theophrastus, and could have been easily propagated in other provinces of this Empire.

Herodotus records that Nebuchadnezzar caused the famous gardens of Babylon to be constructed in compliment to his wife, who was accustomed to the delightful climate of Media. Nothing could be more natural than that upon this occasion the citron be carried to Babylon, whence it could be spread in the neighboring provinces. At the time of Dioscorides it was, without doubt, acclimated in Cilicia. This physician speaks of it in a way to make us think it was naturalized in the district where he lived. He calls it *Pomme de Media* or *cedromeles*, and says that the Latins named it *citron*.

Once cultivated in Cilicia, the citron would, naturally, soon be in Palestine, which at that point touched Persia, and had so many relations with that vast country.

We have already said that as soon as the Hebrews knew of the tree, they devoted it to their Feast of Tabernacles, in which their law ordered them to carry the fruit of the finest tree; and we see by the Samaritan medals, reported by Otius, that this usage was very ancient.

Although it could not have been cultivated in Palestine at that time, it is to be believed that the Hebrews hastened to naturalize in their own

land a tree which they had consecrated to a religious use. The climate of Palestine would assist immensely in this attempt, and, doubtless, at the time of Josephus, they had already succeeded.

This historian speaks of the citron under the name of *Persian-apple*; but this name, connected with its origin, was the one received among the Greeks for designating the citron, and was always used by them even after it had been naturalized in our country.

Besides, Josephus uses in another place the name of *Citrus* (kitrion), and in a manner to prove that it was a production of the country. He tells us in book 13, that the Jews being in revolt against their king, Alexander, threw citron in his face whilst he was at the foot of the altar celebrating the Feast of Tabernacles; and, although he had said before, in speaking of the tree, that it was the custom in this solemnity to fasten the Persian-apples to palm branches, he says *here*, that they were accustomed to carry boughs of the citron. How shall we explain this abundance of citrons, shown by the little account made of them in using them as missiles, and by their carrying branches of the tree, unless we admit that it was acclimated in their country? Otherwise, would they not have been content with simple citrons, as the Jews are who now inhabit the countries farther north?

Nothing could be easier than to make it pass from Palestine to the Grecian isles, and thence to Sicily and Sardinia, where it really is so well acclimated as to seem indigenous.

Most writers who have spoken of the naturalization of the citron in Italy have attributed it to Palladius. Clusius, Bauhinus, Ferraris, and some other partisans of this opinion, base it upon the testimony of that author; but Palladius, far from taking to himself this glory, speaks in such a manner of the citron as to make us think that this plant was already not only acclimated in Sardinia and Naples, but also in the north, where it could not live without the help of artificial shelters and coverings.

This agricultural luxury, unknown to the ancients, and for the origin of which, perhaps, we are indebted to the culture of the citron, proves that the plant had been a long time in Italy, where its culture had spread very much; it was in Sicily and in Naples, and, according to Palladius, it bore flowers and fruit all the year, as in Assyria.

See how this writer expresses himself:

"OF THE CITRON.

"In the month of March one can propagate the citron in several ways—by seed, by *drageon* (root suckers), by *rejeton* (also suckers or shoots), and by *bouture* (cutting). It loves a light earth, a warm climate, and continual humidity. If one wishes to sow its seed it should be done in this way: Spade the earth to a depth of two feet, mixing in ashes, then form small squares so the water may run upon the sides in furrows; in these squares open with the hands a hole of four inches, and place three seeds with their points touching below. After covering, water them every day; they will come up sooner if moistened with tepid water. As soon as the sprouts appear it is necessary to carefully remove the neighboring weeds. Finally, at the third year, the young tree should be transplanted to its place. If one

desires to put in a *drageon*, it must not be buried deeper than one and a half foot, so that it will not decay. It is more easy to plant a *bouture*, which should be of the size of the knife-handle, a foot and a half long, and smooth on all sides, with knots and thorns cut off, but without making the slightest cut upon the point of the bud, which forms the hope of the future sprout. The more industrious people daub the extremities of the cutting to be planted, with compost, or cover it with sea-weed. Sometimes they wrap it in soft clay, and prepared in this way they put the cutting into well-tilled ground.

"The *rejeton* (a sucker) may be more slender and not so long. It is to be buried in a similar manner as the *bouture*, except the *rejeton* must stand out of the ground eight inches in place of being covered entirely, as the *bouture*. As to space there is not much required. The citron tree ought not to touch any other plant; it likes particularly warm and moist places, and near the sea, where it has an abundance of water.

"But if one would force it to grow in a cold climate, it is necessary to carefully put it in a spot well sheltered by mud-walls, or in a southern exposure, and in winter it must be covered with a roof of straw; when summer returns it could safely be put in the air.

"The *rejeton*, as well as the *bouture*, should be planted in autumn in warm countries; in cold sections, on the contrary, they plant in July and August, and water it daily.

"I have, myself, succeeded in thus making them prosper, to the point of giving fruit of extraordinary size. Some think it is advantageous to sow gourds around citrons, and that their vines when burned form an ashes useful to this tree.

"The citron likes frequent tilling; it is the means of getting the largest fruit; they should be but rarely trimmed, unless it be to remove dead boughs.

"They graft the citron in April in warm districts, and in May in colder latitudes, placing the graft, not upon the bark, but opening the stem or trunk near the ground.

"Some say the citron may be grafted upon the pear and mulberry trees, but one should carefully cover these grafted plants with a little basket or a flower-pot.

"Martial assures us that in Assyria this tree is always covered with fruit. I have observed the same in my possessions of Sardinia and Naples, as in those provinces the climate is very soft, and soil moist. The citrons there produce perpetually.

"To the ripe fruit succeeds the green, and to these the flowers. Indeed, Nature seems to have endowed these trees with a continual revolution of fruitfulness.

"One can, they say, make the fruit sweet, sour as they are, by macerating for three days their seed in honey-water, or in the milk of a ewe, which is thought to be better.

"Some cultivators, in February, make at the foot of the trunk of the tree an oblique hole, open at the lower end, from which the sap is allowed to run until the fruit is formed; it is then closed with earth. They pretend that by this process the fruit becomes sweet.

"Citrons may be kept all the year on the tree, and still better in closed vases. When they are

to be plucked for preserving they should be taken from the tree, with bough and leaf, in a night when there is no moon, and placed separately, the one from the other, so they do not touch. Some persons put each one into a vase by itself, seal the vases with plaster, and leave them in a dark place; others save them in sawdust from cedar wood, or in such straw as is used to thatch the trees in winter."

Progress thus marked could not but be the result of a long course of years; therefore we must date the introduction of the citron tree into Italy from a period more than a century before Palladius.

Historians are not agreed upon the time in which Palladius flourished.

The monks of St. Maur, in the history of French literature, insist that the writer of the book bearing the name Palladius was a son of Esuperantius, prefect of the Gauls, a native of Poitiers, of whom Rutilius speaks in his *Itinerary*, and who lived in the fifth century. Others have attributed the book to a Palladius who wrote in the reign of Tiberius. I at first thought that the opinion of the learned Benedictines should be set aside, because the writer upon the citron taught us that he himself had possessions in Naples and Sardinia; but, after a little reflection, I see that it is easy to reconcile their opinion with this fact.

The Roman conquests had made of the world but a single family; it was then not impossible for an inhabitant of Poitiers to have domains in Sardinia and Naples. Moreover, I have observed that Palladius often speaks of Apulia, who wrote, according to Vossius, about the year 218, under the Emperor Macrinus; he would, then, be posterior to this philosopher. This fact might place our agricultural writer in the third century of the Christian era, but as his name does not occur in any writings of that time, and as his Latin savors of the decay of taste, I readily believe that he is the Palladius of Poitiers who lived in the fifth century, according to the authors of the literary history of France.

In adopting this conjecture, otherwise well founded, we shall fix the transmigration of the citron into Italy between the third and fourth century of our era. But many other proofs confirm me in this opinion.

Florentinus, a Greek writer on agriculture of the third century, speaks of the citron as a tree cultivated not only in warm districts, but also in climates where it needed shelter.

In his tenth book he expresses himself thus of the citron: "The citron-tree should be planted near walls so as to be protected on the north. In winter it is necessary to cover it with mounds of straw and the vines of gourds. Rich persons who live in magnificence and luxury plant the citron under porticos open to the south, based upon walls, and they water it abundantly. In summer they open the portico so that the sun can penetrate it to enliven and warm these plants. They cover them at the approach of winter."

The citron, then, was already in Greece at the time of Florentinus, an ornament in the pleasure-gardens of the great. Why should it not have been in Rome and in Naples, where the riches and effeminacy of the court and princes had concentrated splendor and extravagance; also in

Sardinia and in Sicily where the mildness of the climate was so favorable to its culture? The relations of these countries—neighbors and united under one government—were then so intimate and so multiplied that it was not possible for the citron, already valued at Rome, to be cultivated in the gardens of Greece, and *not* in the delightful fields of Sicily, of the Campagna of Rome, and of Tusculum.

We must think it probable, then, that this plant, already in Asia Minor and Palestine at the time of Dioscorides and Josephus, passed into Italy about the third century, and that in the time of Palladius it was grown not only in parts of Italy, whose climate would allow it to grow in the open air, but also in districts less warm, where the luxury and magnificence of Roman grandees built country houses, embellished by art, at great expense.

I would not dare to assert that the citron was at this time cultivated in Liguria and Provence. These districts, which owe so little to nature and so much to industry, had not begun to flourish until after the barbaric invasions.

Maritime commerce created the greater number of the small cities, ornamenting since many centuries the steep rocks of Liguria; they date, for the most part, after the eighth century, and their agriculture, which resulted from their commercial success, did not begin to prosper until the ninth century of our era.

Liguria was in her greatest vigor at the tenth century, but she was so small at the time of which we have been speaking that we cannot believe an exotic plant was cultivated there which would denote a certain degree of civilization not to be found in Liguria at that time.

The culture of this tree made backward steps in the part of Italy where the climate had not permitted it to become naturalized.

The barbarians, who effaced all traces of luxury in overturning the delightful houses of the rich Romans, would destroy this vegetable wherever it exacted care and expense for its existence, but it might still prosper in the isles of the Archipelago, in Sicily, in Sardinia, and in a large part of the Kingdom of Naples, countries remaining under the dominion of the Greeks, and where political catastrophes had not power to exercise their ravages upon its culture, it being there no longer a tree of luxury, but a naturalized plant, existing by the cares of Nature.

It was, then, from these countries that the Ligurians took the citron in the ninth or tenth centuries, since at that time they covered the Mediterranean with their vessels and began to contend with the Venetians for the commerce of the East.

In 1003 we find the citron much cultivated at Salerno, from whence a prince of the country sent it as a gift to some Norman lords who had delivered him from the Saracens. And we know that Liguria, which has always had commercial relations with the coast of Naples, has, for many centuries, provided the Jews of Italy, France, and Germany with citrons.

The *Riviera di Salò*, since so celebrated for this culture, had not begun to know of the citron until several centuries after. Still later, it was extended to Mentone and Hyeres, and not until the fifteenth century has it been grown in the colder parts of Europe.

ART. II.—*Investigations concerning Lemon and Orange Trees—Unknown to the Ancients—Improperly confounded with the Apple of Hesperides—Acclimated recently in Africa—Opinions concerning their Origin.*

When the lemon and orange trees were brought into Europe, the citron had been naturalized several centuries, but as this event occurred in times of ignorance and barbarism, it has remained buried in the shade which covers the history of that period.

When the study of science and of literature began to revive and to diffuse light in Europe, these two species of plants were no longer new; they had become so multiplied that no traces of their transmigration remained. Because of this, most writers have confounded their history with that of the citron, and have thought that they, like the citron, had been known in Italy since the first centuries of the Roman empire.

The fable of the Hesperides has helped to confirm this error. The golden color of the orange, and even its name, have aided this confusion of the fruits in the mind, which was also very congenial to the taste for the marvellous reigning at that period. Thus has this fruit been accepted by all the world as the golden apple of the daughter of Atlas.

In vain have linguists said that the Greek word translated *apple* could as well be rendered *stock*, and that the fable refers to the sheep with golden fleece carried off by Hercules. In vain has it also been said that the golden apples of the poets might be coins, which, by their color, assisted this allegory; the most celebrated critics have persisted in believing them to be oranges.

The Hesperides were placed by some geographers in an African island, thought to be no other than the Fortunate isles (Canaries), now covered by a great quantity of oranges; and by others, upon the west coast of Africa, whose warm climate is specially suited to the culture of this tree; all this gave rise to the belief that, in their voyages on this coast, the Egyptians and Greeks, having found orange groves, had from this invented the fable of Hercules and the enchanted gardens of the Hesperides.

It is easy to show the folly of this opinion. The fable speaks of Hercules stealing golden apples in this wonderful garden, yet makes no mention of a tree as delicious for shade as it is agreeable by the perfume of its flowers.

Ovid said its branches and leaves were of gold; and it is easy to be convinced by the manner in which Homer and Hesiod speak, that this tree owed its existence to the imagination of poets who had invented *golden* apples but to embellish and brighten their picture by the idea of the precious metal. The Hesperides, say some, were upon the west coast of Africa. They were, perhaps, upon the sea-coast of the Cape de Verd islands, or else in the Canaries, which were known to the ancients under the name of Fortunate isles. Now, in these places, which certainly have been visited by Anonus, and perhaps by other voyagers before and since him, not only is the orange not indigenous, but it was not found except where it had been carried by Europeans. If we examine the description made by Anonus, in his Periplus, of

the coasts he had visited, and that which Scyllias wrote of the gardens of the Hesperides, we shall find no mention in either of this tree, although Scyllias has described exactly all that he found. The Hesperides, according to Strabon, were in an island of Libyia (Georg, 2d bk., p. 84), and Scyllias describes the garden (in Periplo, p. 46). Is it to be presumed that these writers had seen it and were not impressed by the sight, as were travellers who preceded them? I have noticed the same silence among the first voyagers who, under Prince Henry, of Portugal, discovered all this coast. I have attentively read the narrations of Alvise da Cadamosto, the history of Barros, the voyage of Vasco de Gama, and many others, and have not found a passage which could refer to the orange this side the Cape of Good Hope.

Notwithstanding, these travellers have not forgotten to speak of those they saw in Ethiopia, or country of Prete Jean. They remark at Madeira the tree, which they call *cedre*, also the *lotus*, already mentioned by Scyllias. They tell us the shores of the Cape de Verd and neighboring isles are pleasantly ornamented by trees always green, which they do not describe, but which we know were not oranges.

I have thought for a moment that the orange was originally in the Canaries, when Louis da Cadamosto, in his voyage in Guinea, written in 1463, speaks in a seemingly truthful manner of this tree being well known in those islands; but I have remarked that not a word is said of it in the history of the discovery and conquest of the Canaries, written in 1402 by M. Jean de Bethencourt, in which, however, he speaks of palms and other trees. Consequently, I believe that from Spain and Portugal the orange passed into these islands, where, in sixty years, it had certainly multiplied and become known.

Leon, the African, who wrote at the end of the fifteenth century the description of the interior of this country, even to beyond Mount Atlas, where now there are so many oranges among the palm trees, found none, except in the Kingdom of Cano (ancient Canopus, near Egypt), and we know that this district must have had for a long time commercial relations with the Arabs, who had already introduced the orange tree into Egypt and upon the coasts of the Mediterranean.

We should, then, conclude that to the Arabs Western Africa is indebted for this plant, which would thrive there as well as at Madeira and the Canaries, where it had been cultivated since 1463. Before this era it was known only at Morocco, where the Arabs had carried it, and its culture extended scarcely beyond that country, which had been for a long time acquainted with Europe.

If, in Homer's time, there had been oranges upon this coast, they must have multiplied infinitely, and would not have escaped the observation of our navigators, who would have placed the fact in their narrations; but it was reserved for Europe to enrich with this tree those happy climates where the ancients had placed the fortunate isles and the delightful gardens of the daughters of Atlas.

I will not pause to combat the opinion adopted by some writers that the ancients knew the orange under the generic name of *citrus*, or *mala*

medica. It is impossible to apply to it the descriptions made of this tree by Theophrastus, Virgil, Pliny, and the most part of those who have copied them; and if this opinion has some seeming foundation, in regard to the lemon, it is entirely inadmissible for the orange. The more judicious writers have seen the falsity of it, but have imagined another hypothesis no better founded.

It was an old prejudice, generally received among cultivators, that in grafting successfully one species upon another, either new species were obtained, or extraordinary fruit, which resembled at the same time two species. They attribute to this operation, which they consider very difficult of success, the varieties produced by fertilization, and of which they did not know the origin.

This opinion was also adopted by the Arabs. Abd-Allatif tells us that in Egypt it was believed "that the banana tree came originally from the mingling of the colocasia and the stone of the date, and to produce this composite vegetable it is necessary to bury a date-stone in the interior of a colocasia, and thus to plant it."

Prosper Alpin reports the same opinion in another manner, and instructs us concerning the belief that was held in this country relative to the sycamore (*ficus sycamorus*. L.), which was regarded as the product of a graft of fig tree upon the mulberry. He said that some pretend that the banana (*musa paradisiaca*. L.) was the product of a graft of sugar-cane upon the colocasia (*arum colocasia*. L.). See the translation of Abd-Allatif, by M. de Sacy, pp. 28 and 105.

This prejudice or opinion applies chiefly to sterile varieties of plants, and the cultivated banana is of this number; it is a genuine monster, due to fecundation, and in which the fruit is improved at the expense of the seed. We know that its type exists in India, and there multiplies by seed. It is not cultivated in gardens, because its fruit is not as good as that of the sterile variety.

The old writers are full of methods relative to these operations, and of ridiculous recipes to sweeten fruits of a disagreeable taste, or to change their color. Some have applied these fancies to the orange, and many authors have thought that this tree owed its origin to the citron grafted upon the pomegranate or the mulberry, and that the sweetness of these fruits was but the effect of careful culture received in our gardens.

I might report a great number of passages proving how much this opinion was believed. I will, however, limit myself to the following:

Bauhin, in his "Theatre de Botanique," after having said that to obtain the dwarf orange one must graft it upon the citron tree, adds that the orange, unknown to the ancients, is but the product of an extraordinary graft. Salmasius, in his notes to Solinus, says the same thing. It is also the opinion of Nicolas Monardes, cited by Clusius, who insists that the orange is the product of a graft of citron entered upon the pomegranate.

This opinion still exists in the mind of many cultivators with respect to the red-fruited orange and the bizarrerie, and all plants which offer singular varieties. One has but to read the notes to the Italian translation of the "Elements

of Agriculture," by Mitterpacher, vol. 2, p. 201, to be convinced of this.

We have already, in the early part of this book, shown how this opinion is without foundation. It is based upon no well known fact, and a thousand experiences unite to disprove it. However, ignorance of the true cause of these varieties and extraordinary productions, has credited it, and with the necessity for assigning a cause for a phenomenon recognized as really existing, this system was received even by physicians and naturalists.

These principles have also been applied to the lemon, which some have thought was the result of culture and extraordinary grafts. I have already demonstrated that this plant cannot owe its existence to fecundation, since it has features peculiar to itself, which are constantly reproduced by seed, and which make it known as a mother species. There only remains for me to prove that it was not known to the ancients, either under the generic name of *mala medica*, or any other appellation.

The Persian apples described by Theophrastus and Pliny bear all the characteristics which belong to the citron, and we do not see that any old writer has observed that there existed two kinds. This could not have escaped Palladius, Florentinus, Constantine, Galen, or Dioscorides, who, either as writers on agriculture, or as physicians, ought to have appreciated the difference between the lemon and citron, in their relation to agriculture, as well as to medicine. Therefore their silence should be considered, in good criticism, as not only a negative proof, but as positive data; while the exclusive mention they have made of the properties of this species of fruit, without presenting any of those which could belong to the lemon, suffices to give to our conjecture the character of certainty.

Pliny's Natural History speaks of two plants seeming to the casual glance to have points of resemblance with the *citrus*—one is the *citre* of Africa, the other the *thyam*.

The following occurs as a foot-note in the original:

Among the writers who have spoken of the tables of *citre* (*citrea mensa*, Petron.) of which the ancients made so great account, some have thought that they were of the wood of the citron, others, of the juniper, the arbor-vitæ, the savin, the acacia, or the alnug of Scripture. (1st Kings, 10, 12.)

But nothing else than the identity of name and exorbitant price of these tables among the Romans could have given rise to these two opinions, equally unfounded.

It is very true that the word *citrus* has been indifferently employed by the Latins, to designate the African *citre*, (*citrus lybica*, Varron; *citrus atlantica*, Martial; and the citron tree of Media, *citrus medica*.)

We have of this many examples, not admitting of doubt; nevertheless, it appears that this name belonged originally to the *citre* of Africa, and was given to the citron long after as a synonym of apple of Media. All the writers of the Augustan era have applied it only to the *citre* of Africa. We see this in Horace, Martial, Petronius and Lucan.

Pliny is, perhaps, the first to use *citrus* as a synonym of *pomme de medie*, but he gives it also to the *citre atlantique*, and it is because of an error in some translations we see *arbor cedri*. The more exact editions have *arbor citri*.

It is difficult to determine what has caused this confusion. It is not to be attributed to any similarity between the plants, when the descriptions left us by the ancients prove that they were really two very different species.

We have already seen what Theophrastus, Virgil and Pliny have said of the citron. I will now examine what Pliny says of the *citre atlantique*: "The *citre*," he says, (book 13.) "is a tree resembling the wild female cyprus in leaf, in color, and in general appearance." The cyprus, among botanists, has not trees male and trees female; it is a monoecian plant, carrying the two sexes upon one foot, but there is a variety known among cultivators as the female tree, having spreading branches. It seems the ancients called this *cypres male*. They designate under the name of *cypres femelle*, the ordinary cyprus, regarded by us as the type of the species, and in our countries, called male cyprus.

Millar says that the cyprus with spreading branches is a peculiar species; but all accustomed to cultivate it, consider it as a variety, and I can affirm that I have seen this spreading cyprus grow among pyramidal cyprus, in seed-beds, where the seed had been gathered from cyprus, very close and smooth.

This is one of the facts which have driven me to search for the cause of these aberrations to be seen among all plants. But, whatever may be said of this variety, it is always certain that the *citre* of Africa resembles the cyprus, and that it has a pyramidal form, very smooth, which distinguishes it from juniper and arbor-vite.

We must then ascertain if there exists a species of cyprus whose wood is beautiful enough to make these precious tables, costing, as Pliny says, one million four hundred sesterces (\$56,000.)

On reflecting upon the description of this furniture by the Latin naturalist, it appears to me that its beauty depended not so much upon the natural quality of the tree, as upon accidents which accompany, nearly always, the part of its wood of which they were made.

Pliny says the tables were made of the roots, or the knots of the trees, and adds that they were esteemed because of the veins of different colors, or of irregular and capricious waves with which they were mottled, and which gave them a resemblance to the skin of a tiger, or panther, or even to the tail of the peacock.

Now these waves and veins are in the roots of most of these trees, and chiefly in protuberances or exostoses, produced perhaps by a derangement in the course of the sap. We see it in all the species in our southern climate, and principally in the stump or the roots of the olive, the walnut, the box-tree, and in knots and bunches of woods most sought by the cabinet-maker. It would be nothing strange if these precious tables were made of the ordinary cypress, which, grown in Africa, has perhaps more color.

We can believe that at this period, Mt. Atlas was still covered with those old trees which date from the creation, and whose roots have ac-

quired in the long course of centuries, remarkable peculiarities due to old age.

The forests of Madeira and of America offer like examples; they have furnished, and still supply, trees of immense size and rare beauty. But they vanish with time, and their description will be for our posterity an object of admiration, astonishment and doubt.

Pliny says Mount Ancorarius, which had been so famous for its trees, offered none in his time.

Perhaps the cyprus of Mount Ancorarius is of the same species as that found in Southern America, known as *cypres chauve*, (*cupressus disticha*, L.)

This tree (Dupraz' History of Louisiana) grows to a great size, and has protuberances or exostoses, which, at intervals, cross the roots, and grow above the surface of the ground, like boundary posts. This coincides with what Pliny said of the African *citre*, in speaking of Nomp's table, which was nearly four feet in diameter.

However this may be, it is certain that the African *citre* has nothing in common with our citron; this tree furnishes no wood much desired by cabinet-workers; we never see it in the work-shops of Europe, where it does not attain sufficient size to make planks, and where the wood of it could only be had after frost had killed the tree, in which case it would scarcely be fit for working.

The few we know have qualities making them as precious as the tables of the ancients. And we think that though the citron tree may be more abundant in Media, yet its wood is by nature the same as ours.

The orange tree has not enough trunk to be serviceable as wood. It owes to its branches, which spread themselves, its resemblance to the walnut; when despoiled of these, it presents very little wood fit for use. According to Herrera the orange and lemon of Spain have but little wood. The orange is sometimes used for delicate inlaid work; it is very beautiful and durable.

Perhaps they also use the wood in India, but in Europe I think furniture has never been made of it. I have worked some small pieces, and find that it receives polish, and that its clear yellow color is pretty, but it is not remarkably so.

But the *citre* presents no other likeness than its name, which has a singular identity with that of the citron; and the *thyam*, whose name has no sort of connection with either citron or lemon, shows only some equivocal features which might arrest attention, but, on examination, have nothing in common with the lemon. Pliny, who is the only one to speak of the *thyam*, made a vague description of it, yet explicit enough to distinguish it from the lemon. He says: "The plant was sought by one, and rejected with horror by another, because of its odor and its bitterness, and some use it as an ornament to houses." PLINY, bk. 13, c. 16.

These characteristics do not belong to the lemon. It is, in truth, very proper to adorn houses, either on the outside, disposed against a trellis, or within, placed in vases for decorating apartments; but surely no person ever rejected with horror the lemon for its odor, which is most sweet, or for the bitterness of the skin, which is corrected by an aroma so agreeable, and which

never affects the pulp, the principal part of this fruit. These two peculiarities would seem sufficient proof that the *thyam* of Pliny is not the lemon.

ART. III.—*Search for the Native Country of the Lemon and Orange Trees—Originally from India—Passage into Arabia, Syria and Egypt—Brought to Europe by the Crusaders—Etymologies of their Names—Progress of their Culture—Origin of Orangeries.*

The orange and lemon trees were unknown to the Romans, therefore they could only have been indigenous in a country where this great people had never penetrated. We all know the vast extent of this Empire, yet commercial relations extend themselves always far beyond political bounds. If these trees had been cultivated in places open to the traffic of the Romans, their fruits would have become at once the delight of the tables of Rome, given up to luxury. They could not then have been cultivated at this period, except in the remote parts of India, beyond the Ganges.

The north of Europe and of Asia, it is true, were equally unknown to the Romans, but their climates were not at all suited to these plants.

The interior and west coasts of Africa, although in great part deserts and destitute of the moisture necessary to the orange, enclosed, nevertheless, fertile districts where it might have thriven. But the state of culture of the tree at the present time in that country, and the historic facts proving to us that it was not naturalized there till long after, make us certain that it was entirely unknown there as well as in Europe.

It is true, that at the time of the discovery of the Cape of Good Hope, the Portuguese found many citrons and bigarades upon the eastern coast of Africa, and in the part of Ethiopia where Romans had never penetrated; but they found these trees only in gardens, and in a state of domesticity, and we do not know but that the Arabs, who had cultivated them in Egypt, in Syria, and in Barbary, had penetrated into these countries in the first years of their conquests.

There remains, then, for us, only to seek the native country of the orange in Southern Asia—that is to say, in those vast countries known under the general name of East Indies. But these regions were in part known to the Romans, who, since the discovery of the monsoons made by Hippalus, carried their maritime commerce as far as *Muzro* (Massera; an island off the southeast coast of Arabia, *Trans.*) by way of the Red Sea, the navigation of which employed a great number of vessels, and whose commerce, according to Pliny, should have been valued at fifty million sesterces (\$2,000,000, *T.*) per annum. Their fleets had penetrated even to *Portum Gebenitarum*, which appears to have been the present Ceylon; and, although these voyages cost them five years of fatigue and danger, nevertheless, the thirst for gold and the luxury of Rome had multiplied to the last degree the vessels engaged in this trade.

We must believe, then, that the lemon and orange did not exist in all that part of the country this side the Indus, and perhaps not even in all the part lying between that river and the Ganges; otherwise, these fruits would have been

extolled by the Roman merchants—where the citron was so much valued; and we should find at least some mention made of them in narratives and voyages descended to us from those ancient times.

If we consult the description of the coasts of India from the river Indus to the Euphrates, which we have in the voyage of Nearchus, one of Alexander's captains; that of the Troglodytes, and coasts of the Indian Sea, by Arianus; the voyage of Iambolus, reported by Diodorus of Sicily, where he gives a description of an isle of the Indian Sea, unknown before him, where he had been thrown by a storm; or, finally, the Indian voyage by Pliny, we find not the least indication of either orange, or even citron; yet Nearchus carefully notes the plants found in his course, and speaks of palms, myrtles and vines; of wheat; and generally of all the trees of Asia, except the olive.* Arianus enlarges upon the vegetable productions of those districts, giving the description of those found in public roads. Iambolus saw, in the unknown island, which appears to have been Sumatra, a grain that we recognize as maize; which has been introduced into Europe since the passage round the Cape of Good Hope.

We must, then, admit that the lemon and orange-trees could not have originated but in the regions beyond the Ganges, and that, in early centuries of the empires of the Cæsars, they had not yet been brought from those climates where they were indigenous. They increased perhaps still without culture in the midst of woods, the hand of man not having yet appropriated them as ornaments for his garden. But this event could not long be delayed. The beauty of the tree, and the facility with which it reproduced itself, would naturally extend the culture to adjoining provinces; and the European, quick to seize the productions of all the rest of the globe, would not fail to enrich himself from these regions.

Facts prove that this result has been reached, but we know not the date of this passage, or the circumstances favoring it.† We will now make this the object of our researches.

The Romans at the time of Pliny had extended their commerce on the side of India, as far as it was ever carried during the empire; the power of Rome, instead of increasing, only became weaker from this period; and the fall of the western portion was accompanied in Europe by the decay of letters, arts, agriculture, and commerce.

In this general overturn, the Greeks preserved, it is true, with a taste for arts and luxury, some relations with India, but trade with those countries had never taken other course than by way of the Red Sea, and this was closed from the seventh century by the Arabian invasion of

* Of all the trees of Asia. This is the expression of the text; it is clear he means of the Asia known at that time.

† It is surprising that so little effort has been made to learn the history of the orange, while so many less agreeable trees have been sought out. Sprengel, even, who has labored so much for his learned work on the History of Botany (*Historia Rei herbarie*, Amstelodami, 1807), is silent upon all concerning this plant. He has, however, drawn from nearly all the writers who have furnished me the data thrown together in this book; and he shows a profound acquaintance with authors who can throw light upon this subject.

Egypt, which soon followed the invasion of Arabia by the Barbarians of the West (Ethiopians, &c.).

The commerce of these rich lands must then have taken a much longer and more dangerous route. The traders were obliged, after going down the Indus, to reascend that stream, and by the Bactria (Balkh) to reach the Oxus—and finally, by the last, pass into the Caspian Sea, from whence they went into the Black Sea by the river Don.

But this long and dangerous voyage was never undertaken by the traders of Constantinople: they would not have been able to traverse with safety such an extent of country, partly a desert, and in part inhabited by wandering tribes, most of them nations with whom they were nearly always at war, and who were destined, in the end, to swallow the Greek Empire.

They therefore limited themselves to receiving upon the borders of the Caspian sea, the merchandise of India, brought to them by intermediate people.

One can scarcely realize that in such a state of affairs the orange tree could pass into Europe, for this beautiful part of the world had never been in so general disorder or had so little intercourse with India. Her luxury and commerce were nearly annihilated, and the Arabians, whom the new religion of Mahomet rendered fanatics and conquerors, menaced, on one side the tottering empire of the Greeks, and on the other threatened to plunge into barbarism the West, just beginning to be civilized. Yet it was precisely at this point of time, and by the conquering spirit of this people, that the great changes were prepared which should revive and extend farther than ever before the commercial relations of Europe with Asia, and of Asia herself with the more distant regions of her own continent.

The Arabs, placed in a country which binds together three grand divisions of the globe, have extended their conquests into Asia and Africa, much farther than any people before them. Masters of the Red sea and Mediterranean, they had invaded all the African coast this side of Atlas, and penetrated beyond to the region of the Troglodytes (Ethiopians living in caves—*Trans.*), the ancient limit of the Roman establishments on the east coast of this Continent; they had made settlements there, and according to the testimony of a historian of the country, cited by Barros, they had populated in the fourth century of the Hegira (A. D. 944), the towns of Brava, Mombas, and Quiloa, whence they extended themselves to Sofalo, Melinda, and to the islands of Bemba, Zanzibar, Monfra, Comoro, and St. Laurent. On the side of Asia they had carried their conquests, in the third century of the Hegira, to the extremities of the Relnahar, and towards the middle of the fourth century, under the Selucidae, they had established a colony at Kashgar, the usual route of caravans to Toorkistan or to China, and which, according to Albufeda (a geographer and historian, of Damascus, *Trans.*), is situated in long. 87 deg. (73 deg., 57 min.—*Trans.*), consequently they had penetrated very far into Asia.

Never had there been in Asia an empire so vast, and never had the commerce of nations so near Europe been pushed as far into India.

A position thus advantageous and favorable to the commercial spirit and love of luxury which succeeded, among the Arabs, the fury of conquest, would naturally cause them to learn of and to appropriate many exotic plants peculiar to the regions they had conquered, or to the adjoining countries.

Fond of medicine and agriculture, in which they have specially excelled, and of the pleasures of the open country, in which they have always delighted, they continued to profit with eagerness from the advantages offered by their settlements and the hot climates which they inhabited.

Indeed, it is to them that we owe the knowledge of many plants, perfumes, and Oriental aromatics, such as musk, nutmegs, mace and cloves.

It was the Arabs who naturalized in Spain, Sardinia, and Sicily the cotton-tree of Africa, and the sugar-cane of India; and in their medicines we for the first time hear of the chemical change known as distillation, which appears to have originated in the desire to steal from nature the perfumes of flowers and aroma of fruits.

It is, then, not surprising that we are indebted to them for the acclimatization of the orange, and lemon-trees, in Syria, Africa, and some European islands.

It is certain that the orange was known to their physicians from the commencement of the fourth century of the Hegira. The Damascene has given, in his Antidotary, the recipe for making oil, with oranges, and their seeds (*oleum de citrangula, et oleum de citrangulorum seminibus*. Mat. Silv., f. 58), and Avicenna, who died in 428 of the Hegira (1050), has added the juice of the bigarade to his syrup of alkedere, "*et succi acetosilatis citri (otrodj), et succi acetosilatis citranguli (narendj)*."

These two Arabians seem to have first employed it in medicine. I have examined with care the authors of this nation who preceded these, and find in no other the least hint relating to these species. Mesue, even, who speaks of the citron, says not a word of orange or lemon.*

I have observed, on the contrary, that Avicenna, in giving his recipe for making syrup of alkedere, in which he puts juice of the bigarade, announces it as a composition of his own invention.†

This circumstance would indicate that this fruit had been known but a short time in Persia; but it suffices that it was cultivated there to prove that it might, at once, pass into Irak (probably Irak-Arabee, in Asiatic Turkey, comprising Bagdad, *Trans.*), and into Syria. These countries, which joined, were also connected by political ties, which facilitate communication, and their inhabitants were more civilized than before or since.

A passage by Massoudi, reported by the learned M. de Sacy in the notes to his translation of Abd-Allatif, a writer of the twelfth century of our era, seems to confirm our ideas upon this

* Mesue, who was of Syria, appears to be the first to mention confects of citron, but he says nothing of the lemon or orange. Sylvius, who commented on him, observes that these confections were more efficacious than those of oranges (*anacardium*), which are, however, much used.

† Avicenna, bk. 5, page 289—Edition of Venice, by Valgrisiun, 1564.

subject, and to determine the date of this event. It accords with all the data just given, and with historic facts that we have collected. He expresses himself thus: "The round citron (*otrodj modawar*) was brought from India since the year three hundred of the Hegira. It was first sowed in Oman, (part of Arabia, *Trans.*) from thence carried to Irak, (part of Old Persia, *Trans.*) and Syria, becoming very common in the houses of Tarsus and other frontier cities of Syria, at Antioch, upon the coasts of Syria, in Palestine and in Egypt. One knew it not before, but it lost much of the sweet odor and fine color which it had in India, because it had not the same climate, soil, and all that which is peculiar to that country."

The lemon appeared perhaps a little later in these different countries, for we see no mention of it either in the Damascene or in Avicenna, but its description meets our eye in all the works of Arabian writers of the twelfth century; especially in Ebn-Beitar, who has given to it an article in his dictionary of simple remedies. The Latin translation of this article was published in Paris in 1702 by Andres Balunense. The Imperial library contains several manuscripts of this dictionary.

I had thought to have found proof that the lemon was known by the Arabs in the ninth century; having seen in a history of India and China, dated 238 of the Hegira (A. D. 860, *T.*), of which a French translation was printed in Paris in 1718, the writers had spoken of the lemon as a fruit found in China. But M. de Sacy, who examined the original, ascertained that the word *limon* was inserted by the translator; in the Arabian text one finds only that of *atrodj*, which signifies merely *citron*. Therefore this history,* far from proving that the Arabs knew the lemon-tree at this period, proves quite the contrary.

It was not until the tenth century of our era that this warlike people enriched with these trees the garden of Oman (in southeastern Arabia, *Tr.*), whence they were propagated in Palestine and Egypt. From these countries they passed into Barbary and Spain; perhaps, also, into Sicily.

Leon of Ostia tells us that in 1002 a prince of Salerno presented citrine apples (*poma citrina*) to the Norman princes who had rescued him from the Saracens.†

The expression, *poma citrina*, used by this author, appears to me to designate fruit like the citron rather than the citron itself, then known under the name of *citri*, or of *mala medica*. It is thus that we should recognize the orange in the *citron rond* spoken of by Massoudi in a passage already quoted.

This conjecture accorded with known events and data. The Arabs invaded Sicily about the beginning of the ninth century (828); the orange was taken from India to Arabia after the year 300 of the Hegira—that is to say, early in the ninth century of our era; the citrine apples of Leon d'Ostia date from 1,002, and were regarded as objects rare and precious enough to be offered

as gifts to princes. Thus we have between its introduction into Arabia and propagation in Sicily an interval of nearly a century. In order to conform to the expression of Massoudi, let us suppose that the orange tree was brought from Arabia some thirty or forty years later—say about 330 of the Hegira; if we allow fifty years for its propagation in Palestine, Egypt and Barbary, and finally twenty years for its naturalization in Sicily, we fill precisely the interval between one epoch and the other.

A passage in the History of Sicily, by Nicolas Specialis, written in the fourteenth century, gives still more probability to this opinion.

This writer, in recounting the devastation by the army of the Duke of Calabria in 1383, in the vicinity of Palermo, says that it did not spare even the trees of sour apples (*pommes acides*), called by the people *arangi*, which had adorned since old times the royal palace of *Cubba*. (Nicolas Specialis, bk 7, c. 17.)

The name *Cubba*, given to this royal pleasure-house, seems to refer to the time of the Arab rule; it is probably derived from the Arabic word *cobbah*, meaning vault or arch. Perhaps some grand dome upon this country-house gave the place its name.

These data, however, do not appear to me sufficiently strong to combat the authority of a very reliable historian, who says expressly that the lemon and the orange trees were not known in Italy or France, or in other parts of Christian Europe, in the eleventh century.

Such are the words of Jacques de Vitry, in speaking of Syrian trees, in his History of Jerusalem. The testimony of this bishop, who ought to have known these countries, would appear to have more weight than simple conjectures based upon reasonings from analogy.

Whatever be the authority of this historian, compared with the presumptions advanced by us with regard to Sicily, it will always be decisive respecting Lake Garda and the coasts of Liguria and Provence.

There is not a doubt that in these last named countries the lemon and orange were unknown, not only in the tenth but even in the eleventh century.

But an extraordinary event, destined to change the face of Europe, was to open anew to the people of the West the entrance to Syria and Palestine.

This was also the time when the Crusades, which began at the close of the eleventh century (1,096, *Tr.*), reawakened among Europeans the spirit of commerce and a taste for arts and luxury.

The Crusaders entered Asia Minor as conquerors, and thence spread themselves as traders into all parts of Asia. They were not mere soldiers, but brave men drawn from their families by religious enthusiasm, and who, in consequence, would hold fast to their country and their homes.

They could not see without coveting these charming trees which embellished the vicinity of Jerusalem, with whose exquisite fruits Nature has favored the climates of Asia.

It was, indeed, at this time that Europe enriched its orchards by many of these trees, and that the French princes carried into their coun-

*The original of this history is in the Imperial library. M. Langles, a learned orientalist, is preparing a new translation to be printed at the Imperial press.

† Leo Ostiensis, bk. 2, c. 38. A. D. 1002.

try the damson, the St. Catharine (a pear, *Tr.*), the apricot, from Alexandria, and other species indigenous to those regions.

Sicilians, Genoese, and Provincials transported to Salerno, St. Remo, and Hyeres the lemon and orange trees. Hear what a historian of the thirteenth century says to us on this subject; he had been in Palestine with the Crusaders, and his word should have great weight.

Jacques de Vitry expressed himself thus: "Besides many trees cultivated in Italy, Genoa, France, and other parts of Europe, we find here (in Palestine) species peculiar to the country, and of which some are sterile and others bear fruit. Here are trees bearing very beautiful apples—the color of the citron—upon which is distinctly seen the mark of a man's tooth. This has given them the common name of *pomme d'Adam* (Adam's apple); others produce sour fruit, of a disagreeable taste (*pontici*), which are called *limons*. Their juice is used for seasoning food, because it is cool, pricks the palate, and provokes appetite.

"We also see cedars of Lebanon, very fine and tall, but sterile. There is a species of cedar called *cedre maritime*, whose plant is small but productive, giving very fine fruits—as large as a man's head. Some call them *citrons* or *pommes citrines*. These fruits are formed of a triple substance, and have three differing tastes. The first is warm, the second is temperate, the last is cold.

"Some say that this is the fruit of which God commanded, in Leviticus: '*Take you the first day of the year the fruit of the finest tree*'"

"We see in this country another species of citrine apples, borne by small trees, and of which the cool part is less, and of a disagreeable and acid taste; these the natives call *orenges*."

Behold, then, the Adam's apple, the lemon, the citron, and the bigarade found in Palestine by the Crusaders, and regarded as new trees foreign to Europe.

This passage does not accord, as far as the citron is concerned, with what Palladius says. He tells us that this plant was, in his time, cultivated in Sardinia and in Sicily. But we see, by Jacques de Vitry, that the citron of Palestine was distinguished by the extraordinary size of its fruit, equal to a man's head, and it must be that this last was a variety unknown to Europe.

It is, indeed, only since this epoch that we find in European historians and writers upon agriculture any mention of these trees.

Doubtless the Arabians had already naturalized them in Africa and Spain, where the temperature favored so much their growth.

Doubtless Liguria is the part of Italy where the culture of the Agrumi has made most progress. We have certain testimony to this in the work of a doctor of medicine of Mantua, writing near the middle of the thirteenth century. He says:

"The lemon is one of the species of citrine apples, which are four in number. First, citron; secondly, orange (*citrangulum*), of which we have spoken before; thirdly, the lemon; fourthly, the fruit vulgarly called *lima*. These four species are very well known, principally in Liguria. The lemon is a handsome fruit, of fine odor; its form is more oblong than that of the orange, and, like the orange, it is full of a sharp, acid juice,

very proper for seasoning meats. They make of its flowers odoriferous waters, fit for the use of the luxurious."

"The trees of these four species are very similar, and all are thorned. The leaves of the citron and lime are larger and less deeply colored than those of the orange or lemon. The lemon is composed of four different substances, as well as the citron, lime, and orange. It has an outer skin, not as deep in color as that of the orange, but which has more of the white; it is hot and biting, thus it shows its bitter taste. The second skin, or pith, between the outer skin and the juice, is white, cold, and difficult to digest. The third substance is its juice, which is sharp, and of a strong acid, which will expel worms, and is very cold. The fourth is the seed, which, like that of the orange, is warm, dry, and bitter." (See Mat. Silv., *Pandectæ Medicinæ*, fol. 125.)

This testimony of Silvatius is strengthened by all the authors who have written upon the *citrus*; there is not one but is convinced that these trees were for a long time very rare in Italy and in France, and that Liguria alone has traded in them since they were first known there.

Sicily and the kingdom of Naples cultivated, perhaps before the Ligurians, the citron and orange trees, but in spite of the advantage of climate, it was only as objects of curiosity, limited to some delightful spots.

This fact is established by the manner in which most writers of the twelfth century express themselves on this subject. Hugo Falcandus, who wrote of the exploits of the Normans in Sicily, from 1145 to 1169, saw there lumies and *orangers*, and points them out as singular plants, whose culture was still very rare. (Hugo Falcandus. See Muratori, *Rerum Italicarum Scriptores*.)

Ebn-Al-Awam, an Arabian writer upon agriculture at Seville, near the end of the twelfth century, and whose work, translated into Spanish, was published at Madrid in 1802, speaks as if the culture were very much extended in Spain.

Abd-Allatif, who was cotemporary with the last named author, expresses himself in like manner, and describes also a number of varieties cultivated in his time in Egypt; a circumstance showing that these trees had greatly multiplied.

Their progress was slower in Italy and France. It appears that the lemon tree, brought first into these parts as a variety of citron, was for a long time designated by European writers under the generic name of *citrus*, although in Italy and the south of France the people had known it from the beginning under the proper name of *limon*; a name which has come down to us without submitting to any change.

In fact, we find it in botanical works called *citrus limon*, or *mala limonia*, and sometimes *citrus medica*. The last was indefinitely used to designate lemon, citron, and orange, and very often the genus *citrus*.*

*It is not until the middle of the sixteenth century that we begin to find in Latin authors the differing species of *citrus* under different names; but one sees that this nomenclature was not well settled in the language of the learned.

Judoco Hondio, in his *Nova Italiae Hodiernæ Descriptio*, printed in 1626, says the plain of St. Remo was covered with *citreis*, *medicis*, and *limonibus*. He begins to give the lemon its own name, and to distinguish it from citron;

The orange appeared in Italy under the name of *oranges*, which the people modified according to the pronunciations of the different sections, into *arango*, *naranzo*, *aranza*, *aranzo*, *citrone*, *ce-trangolo*, *melurancio*, *melangolo*, *arancio*. One meets successively all these names in works of the thirteenth, fourteenth, and fifteenth centuries, such as those of Hugo Falcandus, Nicolas Specialis, Blondus Flavius, Sir Brunetto Latini, Ciriffo Calvaneo, Bencivenni, Bocaccio, Giustiniani, Leandro Alberti, and several others.

The Provençals also received this tree under the name of *oranges*, and have changed it from time to time in different provinces, into *arangi*, *airange*, *orange*, and finally *orange*. (See Glossary of the Roman Language, by Roquefort.)

During several centuries the Latin authors found themselves embarrassed in designating this fruit, which had no name in that language. The first who spoke of it used a phrase indicating its characteristics, accompanying it with the popular name of *arangi*, latinized into *oranges*, *arangias*, *arantium*.

Thus, Jacques de Vitry, who calls the oranges *poma citrina*, adds, "The Arabs call them *oranges*." And Nicolas Specialis designated them as *pommes aigres* (*acripomorum arbores*), observing that the people call them *arangias*. These have been followed by Blondus Flavius and many others.

Matheus Silvaticus first gave to the orange the name of *citrangulum*,* and this denomination seems to have been followed for a long time by physicians and translators of Arabic works, who have very generally adopted it for rendering the Arab word, *narindj*.

Thus, *citrangulum* was received for more than a century in the language of science; finally, little by little, were adopted the vulgar, Latinized names in use among other writers, such as authors of chronicles, etc.; and they have written

but what is this he calls *medici*? Evidently it must be the orange.

Alberti, in his voyage to Italy in 1528, uses the Italian names of *aranci*, *cedri*, *limoni*, etc.; but Giustiniani, who in 1500 wrote the History of Genoa, in Italian, savoring of the *patois* of his country, uses names analogous to those used by Hondio, long after. *Il territorio di S. Remo* (said he), *e tutto pieno di citroni, limoni, cedri, e aranci*.

We easily recognize in these, the four species, now called bigarade, lemon, citron, and orange. But writers were slow to adopt them into living or dead languages, Greek or Latin; and there have been rigid purists, who liked better to form new words drawn from the ancient name of *citrus*, of which these species were regarded as modifications, rather than to use these foreign words, thought to be barbarisms. Thus, were created the Latin words, *citrangulus*, *citradus*, *citronus*, and the Italian names *citrangoli*, *cedroni*, *melangoli*, etc.

In France, they have pushed this purism of language so far as preserving to the lemon in ordinary language the name of citron; and have adopted the words *limonade* and *limonadier*, because those who sold this drink came into France during the ministry of Cardinal Mazarin, and knew no other than their Italian names.

Of this we have proof in an injunction to the *limonadiers*, reported by Delamar in his Treatise of Police, where, speaking of these merchants, he says: *Qui liquorum ex citris expressum vendit, poculorum, citreorum, populo*, . . . bk 1, p. 204.

No doubt these *citri* were lemons, but this name was considered a vulgar word, and, writing in Latin, one thought he could not use another word than *citri*, which was regarded as the only technical term. It is in following these principles that the word *citron* has continued to be used for lemon, in the ordinary language of France.

* Mat. Sil., Pandectæ Medicinæ, p. 58.

successively, *arangium*, *arancium*, *arantium*, *arantium*, *nerantium*, *aurantium*, *pomum aureum*.

The Greeks followed in the same steps; they have either Grecianized the name of *nareng*, which was in use among Syrian Arabs, or they received it from the Crusaders from the Holy Land, and have adopted it in their language, calling it *nerantion*.*

These have, however, always been considered vulgar names, and, in general, the better Latin writers have made use of the generic name, *citrus*, for designating the *Agrumi*.

This usage, followed by most of the writers on history and chorography, often occasions uncertainty and difficulty in researches concerning the beginning of this culture in the different countries where these trees have been introduced.†

* In the islands of the Archipelago they call the orange, in common language, *nerica*.

† Etymologists of all nations have sought for the origin of the names *citrus*, *limon* and *aurantium*. Persuaded that these trees had been known by Greeks and Romans, they have expected to find them only in the languages of these two peoples; and this assumption has given birth to all conjectures concerning the origin of these words.

We do not propose to examine separately each of the etymologies offered; it suffices for combating them that we present the result of our research and observation.

We are forced to admit that the citron was known very anciently by the Greeks; but they have never designated it as other than *Median apple* (*pomme de Médie*).

The word *citrus* did not pass into their language until the second century of the Roman Empire, and in adopting it they gave it a national termination (*kitrion*), just as the Latins did upon receiving from them the name of *pomme de Médie* (*malum medica*). One cannot raise a doubt concerning this fact, attested by Dioscorides, who tells us that only among the Latins did the word *citrus* designate apple of Média; and by Phrisimus Arabinus—a Sophist, and cotemporary with the Emperor Commodus—who says positively that in his time the Greeks had adopted this first word as an ancient synonym (*malum medica, quæ nunc citra appellatur*).

It is, then, certain, from these two authors, that first, the Greeks received the word *citrus* a long time after having known the citron-tree; secondly, that we can not find its etymology in their language; thirdly, it cannot belong to the language of the country where the citron was indigenous, for in that case the Greeks would have received it with the tree, and given it to the Latins instead of getting it from them.

We have seen that the Latins themselves for a long time knew the citron only as Apple of Média (*malum medica*). They gave it the name of *citrus* long after, and as a synonym of the name received from the Greeks.

This was not, however, a new word in the Latin tongue; it had been used a long time, and we find it in nearly all the writings of the pure age of literature; but it was not devoted to the designation of the citron-tree, as they knew nothing of it. It was applied to the African tree which furnished the precious tables spoken of elsewhere.

This would seem to indicate that the name originated in the country from whence they came; for the tree of which they made the planks must have had a name among the natives, and the merchants who sold these to the Romans could not but call them by that name. Therefore, it necessarily passed into the language of the conquerors, just as the names of most of the American and Asiatic plants have passed with the plant, or the fruit, into our modern languages.

This conjecture is so natural that it seems to me to require no proof. It is more difficult to explain how this name was applied to the citron-tree.

Ancient writers furnish no passage which can throw light upon this obscure point; but they offer some conjectures well founded. The Romans had very vague ideas of the tree called African *citrus*, and also of the *citron*; they thought of them merely as precious plants furnishing them luxurious objects.

In the infancy of botany, when they had but very imperfect notions of objects, it was easy to confound them, and to persuade themselves that a tree whose wood was valuable ought to produce fruit of great price.

Many circumstances favored this false opinion. The Citrus of Africa had for some time furnished very beautiful

The use of it as seasoning for food, brought from Palestine to Liguria, to Provence, and to Sicily, penetrated to the interior of Italy and France.

The taste for confections was propagated in Europe with the introduction of sugar, and this delicate food became at once a necessary article to men in easy circumstances, and a luxury upon all tables.* It was, above all, as confections, that the Agrumi entered into commerce; and we see by the records of Savona that they were sent into cold parts of Italy, where people were very greedy for them.

ful planks, yet little by little became very scarce, and it was said that this cutting the wood had thinned these trees upon Mount Ancorarius, and that they only grew at the base of Mount Atlas. About this time were brought the first citrons from Asia to Rome. The Romans had no proper name for these fruits, while they had one belonging to the tree which furnished the tables. They found that even the Greeks only knew these fruits by a paraphrase indicating the country whence they came. Nothing more natural than from esteem to give to them the name of a tree of which they were beginning to have only a remembrance, and whose rarity and price seemed to ally it to the newly-imported fruit.

This is founded only on probabilities, but is, nevertheless, more admissible than the conjectures of the etymologists. Those persons desirous to know these should consult Macrobie, in the third book of Saturnales, chapter 19; Athenæe, book 3; Phaniass Eresius, Isidorus, Ferraris, the Lexicons, and the Etymolog. Magn.

It will suffice here to observe that the word *citrum* has also been given by the Latins to a kind of gourd, probably on account of its clear, yellow color, which distinguishes it. From this word has come *citrullus*, whence probably has been derived *citraille*, which in France is given to a kind of gourd. We have but to consult Apicius, who gives the mode of seasoning it, in his treatise upon cooking.

The words *citrinus* and *citrina*, as epithets, were in use for a great number of fruits, after they had been adopted to express the clear, yellow color peculiar to the citron. (Pliny, Nat. Hist.) The etymology of the words *limon* and *aurantium* has been equally sought after in the Greek and Latin languages.

Some have traced back the word *limon* to a Greek word for meadow or prairie, because of the analogy thought to exist between the lemon tree and a meadow in their continued verdure.

The second appears to be formed of the word *aureum*, and some have thought *aurantium* was but a corruption of *malum auratum*, which has been regarded as a synonym of the *malum hesperidum* of the ancients.

All these views have been displayed by a great number of authors, chiefly by Ferraris, in his *Hesperides*; by Saumaise, in his Notes upon Solinus, p. 955; by Octave Ferrari, in his *Origines Lingue Italice*; by Menage, in his Etymological Dictionary of the French language; and by the authors of the Dictionary of Trevoux.

The facts that we have collected upon the history of these plants convince us that these names belong neither to the Greek or Latin tongues. These, as well as all modern languages, received them from the Arabians, who took them from the Malay and Hindoo. It is, in truth, under the names of *limon* and *naregan*, that these trees are to-day known in India. We are assured of this by all travellers and botanists who have described the plants of that country, but chiefly by Gilchrist, a learned Englishman, who, in his Dictionary of English-Hindoo, printed at Calcutta, points out the word *narendj* as belonging to the Hindostanee.

It was, then, from the languages of India that they must have passed into the Persian and Arabic, where they were modified according to the genius of pronunciation.

Those names which by their form must have originated in the Arab tongue, have an uncertain orthography, varying in different authors of that nation. From the Arabic they passed into our modern languages, submitting to some alterations, Latinized and Grecianized by the writers in these two tongues. Thus, of *narendj* has been made the Latin word *arangi*, afterwards changed to *arangi*, *aranguum*, *aurantium*, *aurantum*. Thus, too, have the French formed their words, *arangi*, *arange*, *orange*; the Italians the words *arancio*, *aranzo*, *naranzo*, *arancio*, and the Spaniards the word *naranza*. The word *limonum* has been taken with little change.

* The confection which the Genoese have always provided for the greater part of Europe, were, in the thirteenth century, one of the most highly-prized of the articles of luxu-

After having cultivated these species for the use made of their fruits, they soon cultivated them as ornaments for the gardens.

The monks began to fill with these trees the courts of their monasteries, in climates suited to their continual growth, and soon one found no convent not surrounded by them. Indeed, the courts and gardens of these houses show us now trees of great age; and it is said that the old tree, of which we see now a rejeton in the court of the convent of St. Sabina, at Rome, was planted by St. Dominic, about the year 1200.*

This fact has no other foundation than tradition; but this tradition, preserved for many centuries, not only among the monks of the convent, but also among the clergy of Rome, is reported by Augustin Gallo, who, in 1559, speaks of this orange as a tree existing since time immemorial.

If we refuse to attribute its planting to St. Dominic, we must at least refer it to a period soon after, that is, to the end of the thirteenth century, at the latest.

Nicolas Specialis, in the passage cited on another page, in describing the havoc made by the besiegers in the suburbs of Palermo, regrets the destruction of *orangers*, or trees of sour apples (*pommes aigres*), which he regards as rare plants, embellishing the pleasure-house of Cubba.

Blondus Flavius, a writer of the middle of the following century, speaks of the orange on the coast of Amalfi (a city of Naples, Tr.) as a new plant, which as yet had no name in scientific language (Blond. Flav., Ital. Illust., p. 430), and he extols the valleys of Rapallo and San Remo, in Liguria, for the culture of the *citrus*, a rare

ry. Jean Musso, who, in 1388, wrote a history of pleasure-houses, in describing the manners of his time, says they commenced dinner with *confectum zuchari*, and that most men in easy circumstances provided it as a thing in common use: *Tenant bonas confectiones in domibus eorum de zucharo et de melle*. This is confirmed by all the authors of that period; and we find in the records of Savona, in 1468, the Commune sent as a present to its ambassador at Milan, citrons and lemons. *Profructibus missis Mediolanum ridelicet limonibus confectis et citris*. Liv. d'admin, II.

* The orange tree that one sees in the court of the convent of St. Sabina, at Rome, is doubtless of a very ancient date. An old tradition says that it was planted by St. Dominic. This was a well-established opinion in 1590, and Augustine Gallo, who wrote about that time, speaks of it as a fact very sure. The Father Ferraris saw and described this tree in 1660, and Tamara, about forty years later, did the same.

This plant exists to-day, and grows in a kind of nook or hollow, whose locality agrees precisely with that described by Ferraris. It was carefully tended by the monks of St. Dominic, who regarded it as planted by their founder, and distributed its fruit to the sick as miraculous. There was also a rule among the monks to present of it to the cardinals and Pope, when they should come on Ash-Wednesday to visit this church.

The actual condition of this tree is, however, too vigorous to admit of our thinking this was always the same stem. It is to be supposed that the present orange tree is but a sprout from the old plant, which, no doubt, was cut off in the frost of 1709. What helps this conjecture is the fact that in the time of Ferraris the tree was in a state of extreme old age. It is true this writer said it had at its foot a sprout or rejeton, which promised its renewal, but this is not that sprout, for it must have submitted to the frost of which we have spoken.

The present stem has a diameter of ten inches. It is divided into two branches, well covered, which, in 1806, according to the assertions of the monks, yielded 2,000 oranges.

These fruits have a sour juice, and differ in no way from our bigarades. Indeed, at Rome, they are called *melangoliforti*.

tree in Italy. *Cujus ager* (San Remo), these are his words, *est citri, palmarum, arborum in Italia rarissimarum, ferax*. (Blond. Flav., Ital. Illust., p. 296.)

Lastly, Pierre de Crescenzi, Senator of Bologna, who wrote in 1300 a treatise on agriculture, speaks only of the citron tree. We find in his expressions no hint of lemon or orange.

The culture of these trees, then, had been begun, in the fourteenth century, only in a few places, but was extended in proportion as arts and luxury advanced the civilization of Europe.

The orange was from the first valued not alone for the beauty of its foliage and quality of its fruit, of which the juice was used in medicine, but also for the aroma of its flowers, of which essences were made.*

Pharmacists have employed with success the juice of lemon in making medicines.†

The orange-tree must have been taken to Provence about the time it entered Liguria. It is to be presumed that the city of Hyeres, so celebrated for the softness of its climate and the fertility of its soil, received it from the Crusaders, because from this port the expeditions to the Holy Land took their departure.

We see, indeed, that it was greatly multiplied there, and in 1566 the plantations of oranges within its territory were so extensive and well-grown as to present the aspect of a forest.‡

The territory of Nice, so advantageously placed between Liguria and Provence, would necessarily receive from its neighbors a tree so suited to the softness of its climate, sheltered by the Alps, and to the nature of its soil, fertilized by abundant waters. It appears that the culture had already greatly extended towards the mid-

* From the moment the orange was known, it was used in medicine; Avicenna appears to be the first who used it in making his syrup of Alkade, of which he was the inventor. The Damasene (in Antidotario) began to draw oil from it, and from its seed. (*Oleum de citrangulis, et oleum de citrangulorum semibibus*. Silv., p. 58.) But nothing was so desirable as the perfumes made of its flowers; they surpass in sweetness those of the other species.

Medicine and perfumery have made, and still make, great consumption of these flowers.

† The lemon has been employed also in medicine. Silvatius regards it as an excellent remedy against worms, and says the mothers of Piedmont and Nice made great use of it for the children. He commends the virtues of its skin and of the syrup from its juice for the nausea of pregnant women, and the pestilential fevers.

‡ But the most common use of this fruit was as a seasoning for food; this usage existed in Palestine in the time of Jacques de Vitry (See Hist. Orient., p. 170). It had reached Sicily in the time of Hugo Falconandus; and Silvatius teaches us that this use of the lemon was all over Italy. (See Mat. Silv., Pand. Med., fol. 125.)

It appears that not until some time after did they begin to make the drink known as *limonade*.

This drink originated among the Orientals. It passed into Italy about the middle of the fourteenth century, and into France not until the time of Cardinal Mazarin. (See Menage, Dict. Etymol.)

At this time drinking-shops were opened in Paris, where the public found refreshments composed of sugared water and lemon juice.

These merchants were called *limonadiers*, from the drink they sold. They were united as a body of tradesmen in 1678. In the regulations of police, the name of *limonadiers* is also applied to the coffee-sellers.

§ We read in an ancient book, entitled "Collection of words, during the voyage of King Charles IX., now reigning, accompanied by things worthy of memory, &c., by Abel Jovan, printed at Toulouse in 1566," the following passage: "The king made his entry said day into the city of Hyeres. . . . Around this city there is so great an abundance of oranges and palms and pears and other trees, which bear cotton, that they are like a forest."

dle of the fourteenth century, as we find in the History of Dauphiny that the Dauphin Humbert, returning from Naples in 1336, bought at Nice twenty plants of orange trees. (Hist. of Dauphiny, bk. 2, p. 271.)

From Naples and Sicily the orange and lemon trees must have been carried into the Roman States; into Sardinia and Corsica and to Malta.

The islands of the Archipelago perhaps first received them, because, belonging in great part to the Genoese and Venetians, it is probable they were the intermediate points whence the Crusaders of Genoa and Venice transported the plants to their homes. From these isles the trees have afterwards spread into the delightful coast of Salo on the shores of Lake Garda, where, in Gallo's time (1559), they were regarded as acclimated from time immemorial.

Finally, the orange and the lemon penetrated into the colder latitudes, and perhaps one owes to the desire of enjoying their flowers and fruit, the invention of hot-houses, afterwards called *orangeries*. (The name of *orangerie* is a modern word in the French language. Olivier de Serre does not use it—he calls this kind of inclosure orange-houses, p. 633. The Italian language has no word responding precisely to *orangerie*. We find in some modern authors, equivalent words, such as *aranciera*, *cedroniera*, *citroniera*. FONTANA, *Dizionario rustico*, bk. 1, p. 74. But the ancient writers styled these places for preserving these trees by the phrase, *stanzone per i cedri*. In Tuscany and the Roman States, they call them *rimesse*; in other places they are known under the name of *serre* (inclosure). Mاتيoli says, that in his time they cultivated the oranges in Italy, on the shores of the sea, and of the most famous lakes, as well as in the gardens of the interior, but he says nothing of the places for sheltering them. Gallo speaks of rooms designed to receive the boxes of orange-trees, which were very numerous at Brescia, but he does not designate them by any particular name. The Latin writers also used a periphrase. Ferraris calls an orangery, *tectum hibernum*. Others call it *cella citraria*.)

This agricultural luxury was unknown in Europe before the introduction of the citron-tree. We find not the least trace of it either in Greek or Latin writers.

It is true that from the time of the Emperor Tiberius, in Rome they inclosed melons in certain portable boxes of wood, which were exposed to the sun in winter, to make the fruit grow out of season. These inclosures were secured from the effects of cold by sashes or frames, and received the sun's rays through diaphanous stones (*specularia*), which held the place of our glass. But it seems they used no fire for heating them, and that they merely inclosed thus, indigenous plants, of which they wished to force the fruiting out of season, it being a speculation of the cultivator rather than a luxurious ornament for embellishing the gardens. (PLINY, bk. 19, chap. 5, p. 336, and COLUMELL, bk. 2, chap. 3, p. 42.) It is after the introduction of the citron tree into Europe that we begin to find, among the ancients, examples of artificial coverings and shelters against cold.

Palladius is the first who speaks of these coverings, but only as appropriate for the citron,

and gives no description of them. Florentin, who wrote, probably, after him, describes them at more length; and it seems by his expressions that in his time the citron was covered in the bad season by wooden roofs, which could be withdrawn when there was no occasion to defend them from cold, and which, also, could be arranged to secure for them the rays of the sun. (FLORENT., bk. 10, chap. 7, p. 219.)

This agricultural luxury, which began to appear about the time of Palladius and Florentin, must have been entirely destroyed in Italy by the invasion of the barbarians. I have remarked that Pierre de Crescenti, who wrote a treatise on agriculture in 1300, while treating of the citron, speaks only of walls to defend it from the north, and of some covers of straw. Brunsius and Antonius, quoted by Sprengel, have thought to find in the Statutes of Charlemagne indications of a hot-house. I have closely examined the article cited by those writers, (in *Comment. de reb. Franc. orient.*, bk. 2, p. 902, etc.), but have not found a word that could make me believe this means of preserving delicate plants was employed at that period.

I have even remarked that in these ordinances many plants are named, which Charlemagne wished to have in his fields, but no word to be construed into ordering a shelter for any, unless the fig and almond.

It is astonishing that having spoken in detail of all the parts of the house, of laboring utensils the most ordinary—and even of those of house-keeping—he forgot an object of such great luxury as a hot-house.

But in proportion as civilization and commerce increased riches and extravagance, the fruit of this tree became more sought for, and at the same time, more common: whilst, above all, the properties of the new species just introduced extended its use in medicine, in agreeable drinks, and as a luxury of the table.

At first they were, in cold countries, only a foreign production, procured from the South; but afterwards the people began to covet from the more happy climates the ornament of these trees, and to wish, above all, to embellish with them their gardens.

In temperate climes they began to cultivate them in vases, depositing them during winter in caves; and in the cold latitudes the necessity of struggling against nature, gave the idea of constructing apartments which could be heated at pleasure by fire, and which would shelter the plants from the rigor of the season.

It is difficult to fix the date at which they began to build edifices for protection of oranges. The oldest trace of it that I have been able to find is furnished by a passage in the History of Dauphiny, dated 1336, (we find in this History, printed at Geneva in 1722, an extract from an account of expenses made by Humbert, the Dauphin, in his voyage of Naples in 1336. In the expenses for the return we see the sum of ten tarins—the tarin was the thirtieth part of an ounce of Naples—for the purchase of twenty orange plants. *Item pro arboribus viginti de plantis arangiorum ad plantandum taren.* X. Hist. of Dauph., bk. 2, p. 276). This, it is true, offers few circumstantial details for fixing the fact that the princes of Dauphiny had really, at

that time, an orangery; but as this historian tells us that Humbert bought at Nice twenty roots of oranges for a plantation (*ad plantandum*), it is to be supposed that he had in his palace at Vienna, a place designed to preserve them in the winter; for without this precaution, they certainly would have perished in the rigorous climate of Dauphiny. (In southwest part of France.—*Tr*).

This luxury must have passed immediately into the capital of France, and though I have not yet found in history indications of these establishments before 1500, it is very probable that they were known there about the middle of the fourteenth century.

The celebrated tree, preserved still in the orangery at Versailles, under the name of *Francois First*, or *Grand Bourbon*, was taken from the Constable of Bourbon, in the seizure made of his goods in 1523. And this prince, who, it is said, possessed it for eighty years, could not have kept it except in an orangery. (The orange tree at Versailles, known as *Francois Premier*, is the most beautiful tree that I have seen in a box. It is twenty feet high, and extends its branches to a circumference of forty feet. Spite of that I scarcely believe that this fine stalk dates from the fourteenth century. It is too vigorous, and the skin is too smooth, to be able to count so many years. It is probable that in so long a course of time it has been cut, and that the present tree is a sprout from the old root. This might have occurred after the frost of 1709, which penetrated even into sheltered places. One circumstance gives foundation to this conjecture. This tree is composed of two stalks, which both come out of the earth, and have a common stock. This is never the way the tree grows by nature, still less in a state of culture, and from roots held in vases. I have mostly remarked it in the greater number of trees growing upon a stump which had been razed at the level of the ground. In such case one is forced to leave two suckers, because the sap, being very abundant, could not develop itself in one shoot. It would experience a sort of reaction which would suffocate the stump and make it perish. This is a well known fact in the South, where we cultivate largely the orange, and where the trees of double stems are generally recognized as *rejetons*, or suckers from old roots.)

After all these data, we are authorized to think that in the fourteenth century they had begun already to erect buildings designed to create for exotic plants an artificial climate. But at the beginning of the fifteenth century orangeries passed from kings' gardens to those of the people; chiefly in countries where they were not compelled to heat them by fire, as in Brescia, Romagna, and Tuscany. (See Matioli, who says that in his day the orange was cultivated in Italy, in all the gardens of the interior, where certainly it could not live, unless in orangeries. Diosc. c. 132. We also find in Sprengel's History of Botany, that in this country there were at that time many botanical gardens where they cultivated exotic plants; a circumstance which presupposes the necessity of hot-houses.)

About the middle of the seventeenth century this luxury was very general, and we see distinguished by their magnificence and grandeur,

the orangeries of the Farnese family at Parma, of the Cardinals Xantes, Aldobrandini, and Pio, at Rome, of the Elector Palatin at Heidelberg, (*Oliv. de Ser.*, p. 633) of Louis Thirteenth, in France; and even at Ghent, in Belgium, that of M. de Hellbusi, who imported plants from Genoa, and carried his establishment to the last degree of magnificence. (See Ferraris, p. 150, where he describes the orangery of M. de Hellbusi at Ghent, and that of Louis Thirteenth at Paris. The latter has been replaced by that of Versailles, of which the magnificence renders it perhaps the finest monument of this kind to be found in Europe.)

We now see orangeries in all the civilized parts of Europe, it being an embellishment necessary to all country-seats and houses of pleasure.

ART. IV.—*Nature of the Orange Tree among the Arabs and Europeans of the Middle Ages—Sweet Orange Unknown at this Epoch—Observations upon the Native Country of the Different Species of Citrus, and their Transmigration.*

The investigations of which we have just given the result would seem to fix definitely the history of the orange tree. But how much was I surprised when an examination of all the facts I have gathered upon this subject compelled me to see that the tree in question, from the twelfth to the fourteenth century, was not the orange of sweet fruit, but the bigarade!

This observation, of which I shall presently give proofs, awakened in my mind numberless suspicions and conjectures, forcing me to renewed observations and examinations, referring always to the theory of species and their improvement by culture.

I at first suspected that the bigarade tree might be the wild stock of the orange, which the Arabs, having propagated by seed, had afterwards allowed to become debased and to return to its natural state.

But, in proportion as I have obtained results by my own experiments, my conjectures have been changed; and I find myself forced to seek in historical facts the solution of this problem.

These researches, indeed, have brought me to results which agree perfectly with physiological principles drawn from my experiments; and I have had the satisfaction of seeing these two parts of my work leaning the one upon the other reciprocally, and mutually lending themselves to explain phenomena which they seem to present.

I shall now begin to show the data which have convinced me that the orange tree carried by Arabs into Palestine, Egypt, Barbary, and Spain, thence to Sicily, to Liguria, and to Provence, was only the bigarade or sour-orange tree.

These proofs, already very numerous before my arrival in Paris, have been greatly strengthened by new observations, for which I am indebted to the politeness of M. de Sacy.

The Arabs carried the lemon and orange trees first into Arabia, and from that country they propagated them in places where they had established their dominion. But the most ancient agricultural monuments remaining to us of

this conquering people present only bitter oranges.

The Alcazar of Seville is, perhaps, the oldest of those magnificent palaces preserved with so much care by the Spaniards as an honorable witness to the glories and dangers of their ancestors. It dates from the twelfth century; and an Arabic inscription, now to be seen upon one of its portals, and of which M. Bruna has given me a translation, fixes the date of its construction as the year 1181. That which remains the most intact of this antique monument is a large orange grove at the end of the garden. This grove is stocked with trees, showing extreme old age, and all are of sour fruit. The territory around Seville, though covered with orange trees, presents this species only in this grove, and can show no other plantation of so great age. We see, however, many orange gardens whose trees are very old. There is an exact description of such in the Voyage of M. Navagero, Venetian ambassador to Charles V., printed in 1523.

Doubtless the Caliphs of Spain, who were very particular in the embellishment of their gardens, would have preferred to this species the sweet orange, had it been known when this grove was planted.

Africa, the first theatre of Moórish conquests, exhibits also only this species, in places where it has been acclimated since a very remote time.

Witness the woods of orange trees remarked by Jean Leon, near Cano, south of Atlas, the only ones he found in these regions, "and which," said he, "bear sour fruit."

Witness the oranges found in Ethiopia by the Portuguese when they passed into India, and which were sour; also, as Alvarez teaches us in his narration of the voyage he made to Ethiopia in 1520; and Ferraris, too, who relies upon the authority of the relations by missionaries. *In Ethiopia solo, cultu propemodum nullo, nasci poma citrea rara ea quidem, sed visenda magnitudinis et præcipui saporis; aurantia vero acri tantum saporis arguta uberius provenire.*—FER., p. 47.

But we have testimony still more precise and determined, in Arabian works where this plant is mentioned.

The Damascene (Abd-ul-feda) and Avicenna speak of the orange only as a sour fruit, of which may be made syrups. *Aectositatis citri.....et aectositatis citranguli.*

Ebn-Beitar, in his dictionary of simple remedies, makes of this fruit a description agreeing perfectly with what is said of it by those two writers just referred to. He says, "the orange tree is well known; its leaf is smooth, and of a deep green; the fruit is round, and the interior encloses a sour juice similar to that of the citron. The tree resembles strongly the citron tree; its flower is white and of a sweet odor." (Arabian MSS., No. 172.)

Massoudi, who is quoted by M. de Sacy in the notes to his translation of Abd-Allatif, distinguishes the fruit from the citron only by its form, and calls it *citron rond*. And Ebn-Al Awam, in his agricultural book, says that the fruit of the orange tree is round, and that its juice has the acidity of the citron, from which it comes. (Spanish translation, bk 1, p. 320.) But it is not only in Arabia, in Africa, and in Spain, that the orange was known as a sour fruit. Italy pre-

serves some trees which date from the years 1150 and 1200. Such is the Roman orange tree, already spoken of, and which is said to have been planted by St. Dominic.

Ferraris tells us that it has sour fruit, (*acnium pomorum*), and that the rejeton or sprout of it, existing still, is of this species; "for I have myself examined and tasted the fruit."

This opinion, as to the acidity of the orange, is also confirmed by all remaining to us of our ancient writers relating to this tree.

To the testimony of De Vitry is added that of Simon Januarius, Silvaticus, Specialis, Falcandus, and many others.

Nicolas Specialis, in his history of the siege of Palermo, calls it the tree of sour apples (*acripomorum arbores*); and Hugo Falcandus, in his history of Sicily, describes it in the following manner: *Videas ibi, et lumias acetositatē suā condiendis cibis idoneas, et arangias acetosā nihilominus humore plenas interius, quæ magis pulchritudine suā visum oblectant quam ad illud utiles videantur.*

Finally, from the tenth to the fifteenth century, we find not a single passage in history which can relate to the sweet orange; and writers who have made mention of this tree, (the orange), directly or indirectly speak of it as a kind of sour fruit more agreeable to sight by its beauty, than to taste, by its juice.

Nevertheless, the sweet orange has existed since many centuries in China. All travellers certify to this fact; and the large sylvan groves of them found in Japan, Cochin-China, in the vicinity of Canton, and in the Pacific islands, prove that this plant originated there.

We cannot reasonably believe that this species has been obtained by a careful culture in countries so little civilized, and in savage isles where the vegetable kingdom shows only the traces of simple nature. Neither can we admit that the sweet orange is the type of a species, the degradation of which, by neglect, has originated the bigarade or sour orange.

This phenomenon (of which no other vegetable offers a single specimen) should have had, necessarily, results very different from those given to us by history, and by the actual condition of these plants in various parts of the world.

Extraordinary culture could affect only individuals submitted to its action; but in wild places the orange tree itself would always be preserved in its natural state, and nothing could have caused the type to disappear entirely. For, if individual trees abandoned to nature had degenerated to the point of presenting a difference so great as that existing between the sweet and sour oranges, these two species would surely have been found mingled in the fields, and show a gradation of debasement, or amelioration, proportionate to the state of culture, richness of soil, and influence of climate.

But, on the contrary, all data given us by history upon this matter unite to convince us that these two species of orange trees, as well as the two species of citron trees, created separately by Nature, have existed a long time isolated, and have each had a father-land. The citron is found only in Media.

Travelling botanists have also recognized the fact that in parts of India where one meets the

orange in an indigenous state, the citron is there only by culture.

The lemon did not pass into Persia, Syria, and Egypt until after the Arabs had extended their conquests beyond the Indus and the Ganges into regions before unknown, or separated from Western Asia by their political state, their manners, and their religion.

The bigarade appeared shortly before the lemon, and probably it was not found indigenous by the side of the sweet orange, as in that case the sweet fruit would surely have been preferred; at least it would have been associated with the bigarade, and would have followed it very soon into the regions where it has been propagated.

Yet we have seen that the sweet orange tree was still unknown in Europe at the close of the fourteenth century, and it seems not to have been cultivated until towards the middle of the fifteenth century.

It is not easy to determine the different regions where the species were placed originally by nature. Luxury and civilization have mingled them in a way to make them appear indigenous in all hot countries, where their culture is cotemporary with the establishment of agriculture, and the civilization of the inhabitants.

It is only by visiting as a philosopher the interior of countries least cultivated, that one could find the trees in that sylvan and isolated state, which we call *natural*.

The most reliable data, however, succeed in supplying us with proof that this species has existed a long time only in the southern provinces of China, and upon the coasts and isles of the Pacific.

The Indians, in fact, call this fine species by the name of *China* orange, and I have remarked that at Amboyna and Banda, where it is very common, they acknowledge that to China they owe the choicest and sweetest varieties. (See Rumphius.) It is there, certainly, that all travellers meet with the sweet-fruited orange as an indigenous plant; it is from thence, according to tradition, that it passed into India; it is from thence that recently have been received the greater number of the singular varieties now cultivated at the Moluccas, in India, and in America. It is known in all these countries under the name of *China* orange, and it was also by this name known in Europe before the crowd of varieties spread from one district to another, and taking the name of the region whence they came, had confounded the nomenclature of the Hesperides.

In every case it is clearly demonstrated that the original climate of the sweet-fruited orange tree was not that of the bigarade tree, and that each of the four species of the genus citrus had a country whence they have been brought by the industry and luxury of man.

This fact, which we could prove also respecting other genera of plants, is it not an effect of a general law of Nature? Is it not a principle followed by Providence in the distribution of all beings? The Creator has made the *genera* for the earth, and the *species* for the climates.

He has spread equally over all the globe, the greatest number of vegetables; but He has originally modified them into many differing species,

according to the various climates where they should live.

Man, alone, has disturbed this distribution. King of Nature, he has assembled under the same sky a crowd of differing beings, which were not assigned to live together. He has thus enriched the climate inhabited by himself, and has assimilated to his system of society the animals and vegetables.

But all this has taken place by degrees, and is the result of a long course of ages. We shall now inquire regarding the time and manner of naturalizing the sweet orange tree in Europe.

ART. V.—*Observations upon the Acclimation of the Sweet Orange—Opinions of Various Writers—Examination of their Opinions.*

It is certainly difficult to follow the history of the transmigration of ordinary plants, which spread themselves slowly and in times of obscurity; but it is surprising that we find no traces of the passage of the orange tree of sweet fruit, which, because of its qualities and the epoch at which we suppose it must have been brought to Europe, ought to have been an object for the admiration of gardeners, and the observations of botanists.

This investigation presents nevertheless, a crowd of difficulties.

An opinion, prevailing among the greater part of writers, has attributed this acquisition to the Portuguese. Valmont de Bomare, in his Dictionary of Natural History, gives details so precise upon this fact, that for a long time I believed it to be incontestable.

He says that at Lisbon, in the Count St. Laurent's garden, there exists the first tree from which have come all the orange trees now ornamenting the gardens of Europe.

Valmont de Bomare, and the other writers who have reported this fact, speak of the orange in general; but I think their expressions should be received as applying only to the sweet orange—it would be unreasonable to connect them with the bigarade. This naturalist cites no authority to sustain his assertion, and it appears as if taken from the Dictionary of Trevoux, who is also silent with respect to the source whence he obtained it.*

It seems that the name of *Portugal*, applied generally to the sweet orange, has accredited the opinion respecting the origin of this tree. But we must observe first, that this name was not known in Europe till about the middle of the seventeenth century, and that previous to that time this species was known under the simple name of *orange douce*, (sweet orange.) Secondly, that from the use made of this name among writers, or among the people of the country where it is received, we see clearly that they have given it only to a variety carried, perhaps, by the Portuguese into Europe, and which may be the red-fruited orange. Indeed, in Arabia even, they use the name of *Portugal* to designate

a sort of orange, just as they use the name of *Italy* to express two kinds of citron trees. We have but to read Niebuhr's Voyage to Arabia, where in remarking these denominations, he says it is believed that the Arabs received from Europe one species of orange and two of citrons. (Niebuhr, bk. 1, sec. 39.) Apparently, the orange of which he speaks is the *narendj* Bortughal, and the citrons are the *Idalia Hoelu*, and the *Idalia Maleck*, of the *Flora Egyptiaco-Arabica* of Forskal.

The opinion of Bomare has been shared not only by Hunter in his voyage to China, and by the most of European writers upon agriculture, but also by learned botanists, such as Loureiro. (See first volume of *Memorias de Lisboa*, page 152.) And I have read, not without surprise, in the *Botanique Historique* of Madame de Genlis, that we can even name the person to whom we owe the acquisition of the orange (Jean de Castro).

Assertions thus positive give to the opinion of Bomare an air of truthfulness, which seems to render it unassailable; but having brought together the dates of the various proofs which I have collected for and against this opinion, I have seen that it is in contradiction to well established facts, and thus deprived of foundation.

The Portuguese did not reach China until 1518. Jean de Castro, born in 1500, could not return from his first voyage until about 1520. Therefore, if the orange were carried from China by the Portuguese, and specially by Jean de Castro, this species should not have appeared in Europe until after the years 1518 or 1520, a fact impossible to prove.

It would be more probable to suppose it brought from India by the Portuguese, who penetrated there in 1498. In this case it might be possible for the Count de St. Laurent to have in his garden the first tree seen in Europe. But this hypothesis, whatever appearance of truth it may have, can be combatted with success.

Vasco de Gama, who first doubled the Cape of Good Hope in 1498, said, in his relation of his voyage, arranged by a Florentine who was in his vessel, that in India there were many orange trees, but all with sweet fruit—*Souci melerancie assai, ma tittle dolci*.—RAMUS, bk. 1, p. 121.

It does not seem, from these expressions, that the sweet orange was to him an unknown species; they would appear to denote solely that the bigarade, then very common in Europe, was not cultivated there.

It would be very astonishing, supposing the sweet orange a species unknown among us, if this navigator had not made a remark upon it, and, if he brought the first seed of it to Europe, that he said not a word of it in his relation.

All voyagers of that epoch are equally silent. I have not found a single word to indicate this fact in any of the original voyages collected by Ramusio, nor in any of the contemporaneous histories, which I have read attentively. On the contrary, I have remarked that none of these travellers showed surprise at sight of this fruit, as they did on seeing many others.

But that which radically destroys this hypothesis is, that we have data to prove the fact of the general cultivation of the sweet orange in the south of Europe before this time.

*The oranges of China are thus named, because those we saw for the first time had been brought thence. The first and only tree from which it is said they all come, is still preserved at Lisbon, in the house of Count St. Laurent; and it is to the Portuguese that we are indebted for this excellent fruit. For that reason they are also called *oranges of Portugal*.—DICTIONNAIRE DE TREVOUX, ART. ORANGER.

We find a crowd of writers at the beginning of the sixteenth century who treat of the sweet orange, and not one among them regards it as a new species. They all speak of it as a very ancient tree, whose origin was unknown.

I shall cite Matioli, who printed his translation of Dioscorides in 1540, and who could not have been ignorant of the origin of this species, if it dated from the beginning of this century. His successful study of plants, and the earnest researches he made upon this subject, do not permit us to presume that he could make a mistake in a matter so important and so new. We might say the same of Augustin Gallo, his cotemporary, who enlarges upon the culture of the orange and chiefly of those at Salò, on Lake Garda.

This author speaks also of the orange tree of sweet fruit as a species known since time immemorial.*

Navagero, Venetian Ambassador to Charles Fifth, published his Spanish voyage in 1525. He therein describes the prodigious trees of the *Huerta del Rei* (kitchen garden of the King) at Seville, which may still be seen, and which are all of sweet fruit.

But nothing proves more strongly how this species was spread in Europe, about the beginning of the sixteenth century, than Leandro Alberti's voyage to Italy. This learned monk, who wrote in 1523, speaks largely of immense plantations of orange, lemon, and citron trees, which he saw in Sicily, Calabria, upon the borders of the river Salò, in Liguria, and in many other places.

He expressly says that a great number of varieties were cultivated, chiefly of sweet fruit.†

If the tree owned by the Count St. Laurent were the first to appear in Europe, would it have been possible to propagate it so promptly, and in such abundance, that in twenty-five years it should people the most distant countries with thousands of trees?

At first one would suppose if this species had been brought from India by the Portuguese, they would have followed the easiest method—that of bringing the seed and sowing it at Lisbon. But if we presume that it came as a plant, the hypothesis would then present a crowd of difficulties, rendering it nearly impossible.

Voyages from India were, at that time, very long and very dangerous, being made in small vessels inferior to those in use now.

Crossing the equator was but little favorable to the preservation of vegetables, and the desire of gain, which exclusively occupied those navi-

gators, while hindering their search for objects of taste, would scarcely dispose them to share with a tree the provision of water, so precious and so necessary for all concerned in voyages uncertain and dangerous.

Spite of all these obstacles, I would still admit that the spirit of curiosity of these adventurers might urge them to transplant into Europe, across so many dangers, a tree of India.

All these suppositions, however, will not dissipate the difficulties which we meet in reconciling this hypothesis with facts which I am about to point out.

It was necessary to give to this plant a certain number of years before the Count of St. Laurent (who was, I will assume, disposed to give grafts of it to all the world) could multiply it in his garden, and in the gardens of Lisbon. Afterwards time was necessary for some plants to pass into Liguria, to increase there, and from thence to be propagated in Sicily, in Naples, in Sardinia, and upon the shores of Lake Garda. It is, finally, needful to accord a certain number of years to these grafts for growth, and for sufficient increase to form those magnificent groves which, in 1523, covered the gardens of Italy. All these operations could not have taken place in an interval of twenty-five years—an insufficient time for propagating any plant whatever in any single country.

But I would still suppose the possibility of this propagation. There still remains another problem to solve. How could such rapid and prodigious growth escape the knowledge of so many cotemporaneous agricultural writers, who must have witnessed it, as well as of the botanists who flourished at this time, and of the many intelligent travellers who have gathered the smallest details upon the culture of these trees, and concerning the countries which they have overrun?

We cannot admit such progress in the propagation of the sweet orange without assuming that the cultivators of all countries had a passion for multiplying it, as well as good fortune in transporting it, added to a profound knowledge of the best manner of grafting, and the most reasonable methods of cultivating it, as well as a general knowledge of commerce.

All these circumstances should have made it a noticeable plant, and rendered it an object of attention to botanists and writers of the time.

We are forced, then, to conclude that the sweet orange tree was taken to Europe long before the discovery of the Cape of Good Hope, and consequently could not have been introduced by the Portuguese, much less by Jean de Castro.

But how did it come into Europe? This is the question with which we are about to occupy ourselves.

ART. VI.—*Transmigration of the Sweet-fruited Orange Tree—Conjectures upon the Time of this Event.*

The Crusades have enriched Western Europe with the most of the Asiatic plants, acclimated by the Arabians in the different countries under their dominion, during the best days of their power.

* Gallo did not publish his work on agriculture till 1569, but he speaks of the sweet orange as of a plant whose culture dated from time immemorial, and says that at Salò the old cultivators of ninety years of age could not remember the planting of the trees existing in his time. I have remarked the same in works of physicians, and chiefly in the narrations of voyagers.

† Leandro Alberti, who travelled in Italy in 1523, speaks of the sweet orange tree in a very precise manner, which leaves no room for doubt. "We see there," speaking of Salerno, "citrons, lemons, and orange trees of all the species. Some have sweet, some have sour fruit, and, finally, others, producing fruits of a medium taste." *Dolci, asprelline, e di mezzo sapore.* (p. 192).

He expresses himself in like manner in his description of Liguria, the river Salò, and Calabria, observing that one could walk by the side of orange gardens for more than two miles of road. He regards them, however, as plants known there since time immemorial, and of which the culture was widely spread.

But these warlike apostles, who, during the early centuries of their Hegira, had formed colonies so numerous in the region beyond the Indus, were stopped in their career of conquest, and maintained with these countries a commerce only proportioned to the luxury of the West. This luxury was itself very limited in centuries when the people lived with a simplicity of manners natural to those scarcely emerged from barbarism.

Europeans knew very little of the productions of Asia, except the manufactures of Syria and Persia, which were as yet introduced only among the great. The people, who were then either slaves or soldiers, had but very few wants.

It was not until after the first religious enterprises in Palestine that the Europeans, who had made great advances towards civilization, and who, during their conquests, had acquired a taste for the merchandise of the Indies, sought with avidity the productions of that rich country.

The small amount of trade which, up to that time, had connected Europe with Asia, was carried on in the Caspian sea by the natives of the country, and in the Red sea and in Syria by the Arabs.

Europeans, just beginning to turn their attention in this direction, would buy the few articles of which they felt need in the markets of these people, and on hard conditions.

Difference in religion, and consequently in manners and ideas, rendered it nearly impossible for them to penetrate into the regions of the East. The Arabs, masters of these means of intercourse, not being stimulated by emulation or competition, measured their speculations but by the sales they could make in Europe.

Shorn of their ancient power, and forced, by lack of vessels, by the nature of the country, and by the insufficient police among them, to voyage by caravans, they would buy their merchandise only in the markets of India, where it was carried by the natives.

The Crusades brought about a revolution in the commercial system of these regions. By augmenting among the people of the West the love of luxury and of opulence, they indirectly multiplied the business relations and the industry of all concerned in gratifying these desires.

They opened to Europeans the entrance to Asia, and thus furnished to an active, enterprising people the means of knowing and of extending the trade of India.

From the first the colonies of Christians in Palestine gave facilities for penetrating into those countries, and afterwards the reciprocal want of articles of merchandise to which they were accustomed, added to the love of gain, of which they had tasted the advantages on both sides, maintained among these peoples ties and relations, even amidst the difficulties and fetters presented by the differences in religion, and by political rivalries.

We therefore behold a crowd of adventurers going into the interior of Asia, and on their return to Europe spreading knowledge of those lands and their productions.

The obstacles to, and dangers of, these voyages were very great; but what cannot be done by the human soul possessed with a thirst for gold and passion of discovery?

Often it was necessary to become Mahometans in order to be accepted in the caravan, and it was only in caravans that the Arabs themselves could pass from the Mediterranean sea to the Indian ocean.

They were exposed to an infinity of dangers of every sort, for these voyages offered such, whether they traversed Arabia to Mecca and Aden, or the route of the Persian gulf by Asia Minor, or, finally, that of the Red sea, the most perilous and difficult.

But the enthusiasm for voyaging so filled the minds of Europeans that they would brave all dangers to penetrate into these regions, and the adventures of Marco Polo, Nicolas de Conti, Jerome of Santo-Stefano, and many others, are monuments of the courage and obstinacy of these adventurers. (It is surprising that Marco Polo, who reached China and India, has never spoken of the orange tree. I have carefully read the relation of his voyage, and found but one place where he speaks of the *pomme de paradis*, which is, perhaps, the *Adam's apple*. But it is necessary to observe that this adventurer did not write during his voyage. He could not have done so in those countries, and if he could have written, it would have been impossible to save his manuscript and bring it to Europe. We know that in order to carry his wealth he reduced it to precious stones, which he sewed into the folds of his tunic. Besides, we know that his narration was written at Genoa whilst he was a prisoner, and where, in recounting his adventures, he managed to obtain consideration, which sweetened his captivity. He had not, even then, narrated them except in the societies of Venice, where they did not give an unreserved belief to all offered them of the marvellous. They called him, derivatively, *Marco Milioni*, because of his continual description of riches. We need not, then, be astonished by his forgetting to speak of the orange tree, which he certainly saw in his travels.)

During a long time the adventurers were led only by the spirit of commerce; but finally there was allied to a desire of gain the taste for discoveries, and that passion for plants and foreign arts which have enriched Europe with the secret of glass-making and silk stuff manufactures; with ranunculuses, lilies, Arabian jasmine, and many other flowers, brought into our gardens in the course of the fifteenth century. (Every one knows the great progress in the study of plants made in Europe during the fifteenth century. We have but to consult the learned work of Sprengel, upon the history of botany, to see the large number of plants which passed from Asia into Europe at this epoch. I shall confine myself to citing here one fact, little known, which goes to show the passion of the people of the Occident for the vegetation of the Orient. We read in a little Italian treatise on flowers, printed in Tuscany towards the close of the sixteenth century, that the jasmine of Arabia (*nyctanthes sambac*, L.), carried from the East to the Mediceis, was not cultivated except in the gardens of the Villa Castello, at Florence, where it was guarded jealously as a plant peculiar to this pleasure house. In truth, the plant has not long been elsewhere than in those gardens,

Probably it passed finally, either by complaisance or fraud, into special gardens, and the Genoese, who first acclimated it in Liguria, have since spread it through Europe. It is still from the seedsmen of Nervi that are procured all the plants cultivated in the rest of Liguria, in Piedmont, in Lombardy, and in France. This plant is called in the treatise *Jasmin du Gime* (*Gelsemino del Gime*) a name still preserved in Tuscany. The Genoese call it *gemella*, probably a corruption of *Gime*. It is impossible for me to learn the origin of this name.)

With such a taste for plants, and having so intimate and active relations with Asia, they saw, doubtless, the sweet-fruited orange tree; and the abundance, as well as superiority of its fruit, would arouse the desire to enrich with it, the European gardens. It was, surely, no longer necessary to penetrate into China or the archipelago of Sooloo to find it. It is probable that this plant was spread over India by reason of the progress there made in agriculture and the arts. This progress was, necessarily, the effect of the trade which commerce with Europe had opened to the industry of this country.

Passed from country to country, the sweet orange would take the place of the bigarade in those fine climates where that had been first transported, and would offer its delicious fruit to the people of Hindostan, the fertile valleys of Persia, Hyrcania, and perhaps of Syria.

From these places, already better known, the Europeans would transport it to the southern portions of the Occident.

The analogy existing between the sweet orange and bigarade, might assure these navigators of the possibility of naturalizing it in their native country; while the superior quality of its fruit would tempt their appetites, as well as their desire of gain.

But who among these adventurers was in best condition to project and execute this enterprise?

The Genoese and the Venetians, among Europeans, had then the closest relations with those countries, and the flourishing state of their marine offered more facility for executing this transport. But the Venetians had not, in their lagoons, a climate suited to the culture of the agrumi. They could not, therefore, see in this fruit an object of speculation, whilst, on the contrary, the Genoese inhabited a district already covered with these trees, whose fruit had become a very important article of trade, employing their agriculture, and feeding their manufacturing and commercial industry. (The Genoese found in the culture of the agrumi a source of industry and gain. They encouraged agriculture by extending the consumption of its products, nourishing their commerce by increasing the trade in sugar, which they brought directly from Asia, and sustained their confectioners, who furnished then the greater part of Europe.)

The Venetians, it is true, had obtained more indulgence and favor in the marts of Egypt, and the influence with the Sultans that their gold, their wares, and their marine had given them, made them almost masters of the Red sea trade.

The Genoese, who were driven off by the jealousy of these rivals, made use of scarcely any other route than that of the Black sea and the Persian gulf. But it is necessary to observe that

this last is the only road by which the plants of India are carried to the coasts of the Mediterranean. It presents more facilities for that gradual progression of culture, which is the easy and natural means for naturalizing in a country the plants of a foreign clime, and the only practical way among people little civilized, and who followed but the direct impulses of want.

This route was not intersected by long intervals of desert or of sea—obstacles which always arrest the passage of vegetation and arts—but it offered, on the contrary, a nearly continuous chain of people and fertile lands, of which the soft and moist climate assisted, beyond calculation, the progress of agriculture.

In fact it was by this route that the bigarade tree passed from India into Egypt.

Massondi teaches us that this tree had begun to be cultivated in Oman, whence it went afterwards to Bassorah, thence to Irak and into Syria. The spaces separating these districts at that time offered no great difficulties. Oman, situated opposite the coast of Hindostan, nearly touched Irak by the chain of Arabian mountains, which are very fertile, and it is not far removed from Bassorah, on the seacoast. Nothing easier than to transport upon a vessel, in a short passage, a plant so long-lived, and which sustains itself, perhaps, more than any other without injury, when out of the earth.

Acclimated at Bassorah, the bigarade had nothing worse to cross than very fertile regions, until arrived in Syria, while the fondness of the Arabs of that day for agriculture and for flowers would accelerate its growth.

By this route, also, the orange tree of sweet fruit made its passage into Syria.

Europeans frequented then the markets of this eastern country. Florentines, Pisans, Venetians, Sicilians, Spaniards, and French went there continually as traders and as pilgrims; but the Genoese alone, by their commercial and geographical position, could best favor this enterprise. Masters of many isles in the archipelago, of Sardinia, and of Corsica, they had a sort of chain of establishments, or colonies, which connected their country to Syria, and they could more easily than any others execute the transport of plants, even the most delicate.

Every one knows to what a point of prosperity were carried the marine and commerce of Genoa, from the tenth to the fourteenth centuries. I shall observe solely that it was to the coast of Syria that this industrious people directed chiefly their vessels and their activity.

The Genoese fleets frequented those passages long before the Crusades (see voyage of Ingulphus, Abbot of Croyland, reported by Baronius in 1064, bk. 2, p. 353), and during those famous expeditions it was the Genoese who furnished to the Crusaders the war vessels, the transports, the instruments, the artists for the construction of machines of war, and the food for the soldiers (JUSTIN, p. 28, PAUL-EMILE, GUGLIELMO DE VITRY, and CAFFAR).

From 1097 to 1108 they sent into Syria 337 galleys, and they had so great influence in the success of the Crusaders that Baldwin accorded to them the famous privilege of 1105, the expressions of which deserve record: "*Primi (Genueses) in exercitu Francorum venientes viriliter prefue-*

runt in acquisitione Hierusalem Antiocho; et Laodiceæ ac Tortosæ: Solinum autem et Gibellum, Casaream et Assur per se ceperunt."

This honorable testimony is confirmed by all historians, and chiefly by Morisotte, whose words I will presently give. It is well known, besides, that during the whole of these expeditions they ceased not to support with their fleets the efforts of the Crusaders, and that in the ninth Crusade, in 1243, they transported to Egypt the King, St. Louis, with thirty-two galleys and seven vessels, and had an important part in the taking of Damietta.

Here are the words of Morisotte: *Captis Phœnicie et Syriæ littoribus, uribusque quocumque Saraceni fugere, quocumque erupere, ibi præsto Genuensis cum validis classibus fuisse, nec qui Genuensibus resisteret post Saracenos inveniebatur, si Pisani, Venetique hostes defuissent.* MORISOTUS. Hist., bk. 2, c. 23, p. 514.

According to all these facts, it is evident that the Genoese had, more than all others, facilities for seeing and for bringing to their beautiful shores the lemon and orange trees.

Those sailors who manned the war vessels were the same persons who, after giving some months to tillage, quitted their families to man merchant vessels to go into Palestine, sometimes as traders, sometimes as pilgrims, or disguised as Mussulmen with the caravans into the interior of Persia, and even to India.

Such people, at once farmers, warriors, traders, and adventurers, could not neglect a branch of industry so suited to the climate of the country they inhabited, and which was congenial to the taste for agriculture and for commerce forming the base of their characters. Above all, this conjecture accords so well with facts which we have stated, that we can hazard it without fear of paradox.

They were, besides, the only European people to whom the naturalization of this tree could be profitable, they being for a long time the only ones engaged in the commerce of the Agrumi. This trade was carried on chiefly by the gardeners of Nervi and San Remo.

Nervi has been celebrated for its seedsmen, who provided for a long time, and still supply, these trees to the orangeries of Europe; and to them we are principally indebted for the varieties multiplied by seed, and for the novelties which have gratified the curiosity and taste of amateurs.

The trade in the fruits was monopolized by the inhabitants of St. Remo, who have for many years supplied the citrons used at the Passover by the Jews of Italy, France, and Germany. From their country have come the perfumes and essences, as well as the citric acid, used in the arts. From thence are obtained the lemons for the table, the different fruits for the confectioner, and the sweet oranges have been also for centuries an almost exclusive product of their beautiful valleys.

One may read, in proof of this, what is said by Olivier de Serres, Ferraris, Judoco Hondio, Merula, Matioli, Gallo, Alberti, Volcamerius, Commelinus, Giustiniani, Abram Hortelius, Antoine Mangini, and an infinity of others. Writers of all times have deposited in favor of the almost exclusive trade by the Genoese in the agrumi. We have seen what Silvaticus has said, who

wrote about the middle of the thirteenth century. His testimony is confirmed by writers of the fourteenth century. The first is Brasilius, and the second is Blondus Flavius. The Geographical and Statistical Description of Italy, by Blondus, is, perhaps, the most antique work of this kind known in Europe since the revival of letters. (It dates from 1450.) This author, who was of Forlì, and unacquainted with the part of Italy this side of Tuscany, had recourse to his friends for completing his description. He procured that of Liguria, of Brasilius. This learned Genoese, known by several memoirs relating to the history of his country, wrote then an epistle entitled *Descriptio oræ Ligustica*, a work valuable for the exactitude, precision, and erudition with which it is written, and which Blondus copied almost literally.

In this description (which was also printed) he lauds Rapallo and St. Remo for the culture of agrumi and palm trees, with which those valleys were covered.

Giustiniani succeeded very closely these two authors. He wrote, in 1500, a history of Genoa, preceded by a description of that beautiful coast known as *Riviera di Genova*.

In this he notices the territory of St. Remo, on account of the vast number of these trees, from which the fruit was sent into all Europe.

This testimony is repeated in the works of Alberti, of Matioli, and of Gallo. The first wrote, in 1538, a voyage to Italy, made five years before. The second published, in 1544, his dissertation upon the works of Dioscorides, and the third gave, in 1560, a treatise upon agriculture, highly esteemed—entitled *le dieci Giornate*. These all say clearly that Liguria had been of old celebrated for its trade in agrumi. Many other writers attest to the same. See Hondio, in his *Nova Italie hodierna Descriptio*, p. 73, and Gualdo Priorato, in his description of Genoa, published at Cologne in 1668, pp. 20, 70, &c.

It would be useless to quote the words of Ferraris, of Volcamerius, and a host of others, where the same truth is repeated. I shall only observe that the number of these trees had become so prodigious in the territory of St. Remo, and the exportation of these fruits so considerable, that in 1585 the municipal council of that city thought it a duty to subject this commerce to special police laws. A magistrate was designated to direct it, and express rules were formed for sustaining it.

One sees by these rules that the yearly export of lemons alone amounted to several millions of fruits, and that St. Remo supplied nearly all France, Germany, and many other parts of Europe. I reserve for my fifth chapter this curious paper, which gives an idea of these fruits and their trade.

The extent and antiquity of this trade form, doubtless, a strong presumption for attributing to this people (of St. Remo) the acclimatization of this tree, the presumption acquiring still more force, when we consider their commercial position at the time when this event must have taken place; but I think I shall be able to present data still more decisive for establishing this opinion.

The sweet orange tree was not yet in Europe at the end of the fourteenth century; at the beginning of the sixteenth it was already very

much spread there; it should then have appeared early in the fifteenth century. It was precisely at this epoch that a taste for botany revived in Italy; and at this time the trade and agriculture of Genoa were at the climax of their prosperity. But during all this interval we find no trace of this culture, except solely in Liguria. This fact is attested by two important documents, which I am about to make known.

The first is an account of expenses by the treasurer of Savona, dated 1471. The second is a bill of sale, made in 1472, at Savona, by a master of a ship of St. Remo, of his vessel laden with oranges.

Let us examine these two papers.

The city of Savona had, in 1471, an ambassador at Milan. Wishing to make him a present, she sent to him citron and lemon comfits, and, afterwards, *citruli*. This double expedition, of which we find the account in the books of administration of Savona, dated 1471, is spoken of in a way to prove that the *citruli* were sweet oranges.

It is sufficient to know that the lemons and citrons, sent to Milan, were comfits, and that the *citruli*, on the contrary, were in their natural state.

This plainly shows that the *citruli* were edible, whilst citrons and lemons were not used in commerce, except after a modification by the confectioner, which brought out their aroma, and corrected their bitterness. (I owe the knowledge of this gift, just spoken of, to M. de Belloro, one of the most learned persons of Savona, who kindly made investigations upon this subject in the archives of that city. Here is the passage, copied by myself, from the book of administration, bearing this mark—"1468, H." under the date of "May 27, 1471, p. 327:" "*De mandato S. D. antianorum pro citrulis, missis Mediolanum pro Lazaro Feo, et dictis pro Jacobo de Dego, Gabelotto, Gabelle fornacum anni presentis, grossos decemnovem, cum dimidio libras tres, solidos octo, et denarios tres.*" Below—"Die prima junii, pro fructibus missis mediolanum, videlicet limonibus confectis, et citris, f. 7, 11." The difference in price, and even the expressions indicate that the *citruli* were fruits in their natural state.) This fact is still more strengthened by a contract of sale of coteremporaneous date, found in the archives of the same city. This contract contained a sale made by a master of a St. Remo vessel, to another of the same place, of a barque then at Savona, loaded with 15,000 *citranguli*, or *ceironi*.

(We find in the archives of the notaries of Savona, a bill of sale received by the notary Pierre Corsaro, dated February 12, 1372, by which Dominique Asconzio, family Antoine, of St. Remo, sells to Jean Baptiste Mulo, family Etienne, of same place, one *lembo*, cum *citrangulis*, sive *ceironis*, quindecim mille, now on board said vessel, for the consideration of two pounds per thousand—Genoese money—the whole for the sum of fifty pounds. The *lembo* is a name for a kind of vessel used at that time, which was valued, as we see, at twenty pounds. This price seems very small, but on comparing the value of the money of that day with that of the present, it will be found to be a very considerable sum. I am indebted for these facts to the son-in-

law of M. Belloro—M. Nervi—Secretary of the Mayoralty of Savona, where his talents and knowledge are well known.)

The number, 15,000, of these fruits, is sufficient ground for concluding, First, that the culture of orange trees at St. Remo had reached a high point of prosperity; secondly, that these could not have been bigarades, but were sweet oranges; for what would they do with so many bigarades?

The confectioners were supplied by citrons and lemons. The bigarade also might be confectioned, but one could use for this purpose only the skin, which is thin; and it being impossible to put them into commerce for any other use, it would be extraordinary to find so large an exportation.

It is, therefore, natural to suppose that the 15,000 *citranguli*, or *ceironi*, were sweet oranges, of which the consumption is more considerable, and of which the sale would consequently be more easy and more profitable.

These conjectures seem to me reasonable enough for our deducing that Liguria, at the middle of the fifteenth century, had carried this sort of culture and commerce much further than all the rest of Europe, which could scarcely have occurred in so short an interval had not the Ligurians been the first to know and to cultivate the sweet orange tree.

ART. VII.—Of the Varieties and Hybrids of the Citrus—History of the Origin and Transmigrations—Their Multiplication.

The introduction of the sweet orange tree into Europe certainly preceded that of the most of the varieties and hybrids forming now the family of the Hesperides.

Doubtless a few of these races were formed in the original countries where Nature had placed the species. In the ancient woods of India and China, the mingling of the pollen of many differing individuals would have given birth to the varieties with which those peoples afterwards embellished their gardens, and which, step by step, passed into the bordering provinces, and are at last spread over Europe. But a great number were formed only in the orchards of Syria and Egypt, after the naturalization of the species, which were mixed, the one with the other, by culture. Some varieties have originated only in the gardens of Europe.

The oldest variety known in the Occident is certainly the Adam's apple. It was cultivated in Palestine in the twelfth century, and Jacques de Vitry, who calls it by this name (*pomum adam*), gives us a description so exact as to leave not a doubt of its identity with that we now possess. It is thought that it came from the Indies, where it appears very old, and is regarded as a sub-variety of the pomelous (*aurantium decumanum*). We cannot attribute the same origin to varieties cultivated at about the same time in Egypt. It would appear that those were formed in that country. Abd-Allatif, who describes them, says they were unknown in Irak and Bagdad, countries which served as passage for the lemon and bigarade (*citrons ronds*), and adds, that these species combine with each other, producing an infinite number of varieties. (See ABD-ALLATIF. Description of Egypt, bk. 2, p. 3, translated

by M. de Sacy.) This last observation, remarkable in a writer ignorant of the sexual system of plants, is a sure indication that these new races were formed in Egypt. It is certainly difficult to connect these varieties with those known to us. Some varieties, perhaps, have passed from Egypt into Spain, and thence into the rest of Europe, but they have surely disappeared in great part, with time and want of culture, and have no connection with ours, or only vague resemblances, classing them in the same rank upon the chain of varieties, yet not permitting us to regard them as identical.

I have always been astonished by the difficulty experienced in all the genera, when attempting to connect to our varieties those of the ancients; but since I have become persuaded of the true nature of these races, and of the laws ruling their existence and propagation, my astonishment has ceased, and I am convinced of the impossibility of attaining to this end.

A variety has a precarious existence, due to an accidental combination, and which cannot be perpetuated, except by art. Thus it disappears whenever the action of art is suspended by the effect of some crisis, re-appearing often under forms very analogous, but never identical; forms never complete, having always differences impossible to reconcile.

Because of this, one occupies himself without success, seeking in our orchards the varieties of the olive, the apple, the pear, &c., of which Pliny and Latin writers upon agriculture give us descriptions. These varieties perpetuated themselves then only by culture. This art suffered in Europe by the invasion of the Barbarians, causing these varieties to disappear, and on the return of culture new forms appeared, resembling the old, yet which can never correspond exactly to them.

Perhaps for the same reason we seek in vain, in modern Egypt, the *persea* of Theophrastus, and the *baumier* of the ancients. These two vegetables—regarded by some as two species, the one lost entirely, and the other disappeared from that country—were, perhaps, but two varieties; and from want of care they have submitted to their natural fate. Yet they exist still in their type, and one could obtain them anew, if one could attain to naturalizing this type in an agricultural country, and on a grand scale.

Curious passages of several writers relative to the balm tree, all collected by M. de Sacy in his translation of the Description of Egypt by Abd-Allatif, furnish me with proof of this fact.

I will commence by transcribing these passages, and afterwards give my reflections:

1. Abd-Allatif, in speaking of the balm tree, expresses himself in the following manner: "The tree which furnishes the balsam bears no fruit; they take cuttings of the tree, which, planted in the month of *Schobat*, take root and grow." Abd-Allatif, p. 22.

2. "The wild male balm tree has a fructification, but yields no balsam. It is found in Nedjd (interior of Arabia, *Trans.*); in Tehama (on the coast, *T.*); in the deserts of Arabia, the maritime countries of Yemen, and in Persia; it is known under the name of *bascham*." Abd-All., p. 22.

3. Prosper Alpin speaks of it thus: "*Omnes... uno ore affirmant prope Meccam et Medinam, in*

montibus, planis, cultis atque incultis locis, innumeras balsami plantas sponte natas spectari, plurimasque etiam in arenosis sterilibusque locis, quas tamen vel nihil vel minimum succi producebant. Multa tamen semina ferunt." PROSP. ALP. of Bals. dial. chap. 12, p. 14. DE SACY, p. 93.

4. A Spanish Arab author, speaking of Mecca, says: "Some persons say that the *bascham* (balm tree) has not flower and fruit with their parts. The truth is, however, quite the contrary. At least, if there are districts where such is the case, there are others in which it is not true. The same may be said of the *sorbier* (service tree, *Trans.*) the papyrus, &c." ABOL-ABBAS NEBATI. Man. Ar. of the Imp. Lib. No. 1,071. DE SACY, p. 94.

5. The author of the *Garaib aladiah* says: "One finds in Egypt, in Matareeyah (anc. *Helio-polis*, *Trans.*) balm pits, from whence water is taken to sprinkle the bushes of balm, which furnish a precious oil. It is to the pits that this quality is due, for there the Messiah was washed. There is not in all the world another place where the balm tree will grow. Almelic-Alcamel asked permission of his father Adel to sow the seed elsewhere. Having obtained it, he planted, but his bushes did not succeed, and one could draw no oil from them. Almelic-Alcamel demanded, and obtained still of his father, permission to conduct to his plant the water of Matareeyah, but he had no better success." Ar. MSS. of the Imp. Lib. 791. DE SACY, p. 90.

6. Mandeville reports the following: *Hos arbores seu arbusta balsami fecit quondam quidam de caliphis Egypti de loco Engaddi, inter mare Mortuum et Jerico, ubi domino volente excreverat, eradicari, et in agro predicto (Cayr) plantari. Est tamen hoc mirandum, quod ubicumque alibi, sive prope sive remote plantantur, quamvis forte vireant et exurgant, tamen non fructificant.* MAND. Chap. 8, p. 31. In Haktuy's collection; 1,589. M. de Sacy, p. 87.

From these passages result the following facts: The balm, or balsam tree (*amyris opobalsamum*, L.) in a wild state fruits, and reproduces itself by seed, and gives none, or very little, of this sap called balm. (Nos. 2 and 3.)

In a state of culture it does not fruit, but gives, upon incision, a large quantity of balm. (No. 1.) But it does not suffice to take wild trees in the woods and cultivate them in order to obtain this change. The difference is due to the nature of the individual, which has one of the different properties. Even when a tree is found uniting the two properties, its descendants preserve not the property of their father. They fruit, but do not yield balm. (No. 5.) The tree which fruits is multiplied by seed; that which bears no fruit is multiplied by cuttings. The first (1 and 2) is never in gardens, because we pull it up as soon as it appears; the second is ordinarily only in cultivated places, as it requires the hand of man for multiplying itself; yet we sometimes find it among the wild ones; then it is taken to the garden and cultivated. (No. 6.)

Because of these accidents, which contradict common experience, fables have been created on the subject, and one attributes the power of yielding balm to the quality of the soil, another to miraculous causes. (No. 5.)

All this, which is but a repetition of passages reported by M. de Sacy, proves in an unanswerable manner, first, that there exists a balm-tree type which has flower and fruit, and reproduces itself from seed. Secondly, by fecundation varieties are formed, which most often have the ordinary trait of monsters, sterility. Thirdly, that this monstrous variety, following the example of other vegetable mules, is indemnified for this sterility by a singular property which, in this kind, is letting flow in greater abundance a humor probably destined to nourish fructification. Fourthly, that in nature this variety has existence only during the life of the individual, consequently it cannot perpetuate itself save by art.

Fifthly. That according to all these facts, this variety could have been lost in Egypt, and might have re-appeared in the vicinity of Mecca; and in this place could have shown traits of the ancient variety, modified and changed by accessory accidents, thus causing it to differ from the descriptions of the ancients.

We can apply very nearly the same reasoning to the *persea* of Theophrastus. M. de Sacy has proved very conclusively that this tree is the *lobakh* of the Arabians. He has also proved that it is closely connected with the *sidra* (*rhamnus spina cristi*. Desf.) or *nabka* of the Egyptians.

Why might it not be a variety of that species, whose fruit is larger and more agreeable?

Species never lose themselves in the regions where they are acclimated.

Nature has provided for their multiplication by numerous means which make up the deficiencies of art, and elude the destructive spirit of man. If the *persea* had been a species, it would have, of itself, multiplied itself by its seeds, and the revolutions of Egypt would have only facilitated its propagation. It must, then, have been but a variety due to fecundation, and consequently could be perpetuated only by the cutting or the graft. In this event the character of its fruit would differ from those of its type as much as the butter-pear differs from the wild pear.

Thus all research to find a plant with fruit, answering exactly to that described by Theophrastus, is useless; we must content ourselves with a slight similarity, chiefly with regard to the fruit, and admit that the variety of Theophrastus may have disappeared, but that the species to which it belonged still exists.

One might think it extraordinary that these disappearances have not taken place among varieties of many other plants—the banana, for instance. But I would observe that it (the banana) has received from nature a prodigious facility for reproducing itself by cuttings and suckers; consequently has the power of self-preservation; whilst our fruit-trees require extraordinary care, such as grafting, or careful slipping, which pre-suppose a degree of civilization, and a certain completeness in the culture.

Besides, there are species, which, more often than others, form varieties, and among such varieties there are some which are regularly formed in the ordinary state of blossoming, and others which are the result of an extraordinary combination, taking place very rarely.

From the complication of all these circumstances result the differences seen in these phenomena.

This digression may seem out of place, yet is useful in throwing light upon the principles of the theory advanced by me in the first chapter of this work.

In examining the descriptions of Abd-Allatif, we easily recognize the monstrous citron ("Gros Citron." Abd-All., bk 1, p. 31.)—the citron of sweet-fruit—"citron doux which is not at all acid," Ib.) the lemon-cedrat. ("The lemons, named by some, *composite*; among them are found fruit as large as a water-melon." Abd-All., p. 31.) Ebn-Djemi, quoted by Ebn-Beitar, says: "The composite lemon is a lemon graft upon a citron tree. We add, (continues Ebn-Beitar,) that the skin of this fruit has more of sharpness and bitterness than that of the citron, but less than that of the lemon; it also has a sweet taste, not in either of those fruits. Because of this, it possesses a nutritive quality not found in citron or lemon, and holds a middle place between those two acid fruits." This explanation is precise enough for us to recognize in this variety the *lemon-cedrat* or *poncive*. We also see in his balm-lemon, which is but an inch long and "in the shape of an elongated egg," a race resembling the lime of Naples.

This lemon is certainly the same as the *wild lemons* found by Bellon, near Cairo, "which have fruit never larger than a pigeon's egg." (Bel. c. 36, p. 236.)

Burmanni, in speaking of a kind of *limonia* which he found near Ceylon, connects it to the wild lemons of Bellon; but it is evident that the *malus limonia* of Ceylon, is a *limonellier* (*Limonia*, L.); and Bellon's lemons are true lemon-trees of small fruit, such as the lime of Naples, and the balm-lemon spoken of by Abd-Allatif.

The monsters inclosing another lemon in their interior are but yearly accidents, which might have occurred in the time of Abd-Allatif, as now. ("Some citrons have inside another citron with yellow skin." p. 31.)

In the *mokhattan*, or *sealed lemon*, we see a variety very singular and difficult to recognize. Abd-Allatif says: "There is another sort of lemon called *mokhattan*, that is to say *sealed*, which is of a deeper and more bright red than the orange; they are perfectly round, and a little flattened above and below, as if forced in by pressing there a seal." This peculiar variety resembles none known to us. It appears to be a *lumie* or hybrid of the red-orange and lemon.

According to this writer, it owes the epithet *mokhattan* to the flattened appearance of its extremities.

The conical citron, of which he speaks, is apparently but a modification of shape, which might connect it with varieties cultivated by us; but one cannot determine that, by this single circumstance. ("There are also citrons having an absolutely conical form, beginning in a base, and ending in a point; but which, otherwise, in color, odor, taste of pulp and acidity, differ in no way from the citron." Abd-All.) We have several varieties that affect this form; (the lemon *peretta* is the opposite) and among others, the citron of Florence.

Ebn-Ayyas, in his large History of Egypt, points out also a quantity of these acid fruits, (*hamidhat*) but gives no description by which they can be made known to us.

He names only the citron, the lemon, the orange, the cabbad, the hammadh Schoairi, and the red French lemon which was, it is said, taken to Egypt in the year 300 of the Hegira.

The red French lemon is, perhaps, a variety of the citron. The Franks (a name given by Arabians to all people of Western Europe,) long had known the citron; it is not impossible that they had procured a variety in Sicily or Sardinia, which, carried to Egypt, had gotten the name of *French*, or the name may have come from some Frenchman having cultivated it first in Egypt. (See notes of M. de Sacy upon the first book of Abd-Allatif, p. 117.)

I shall not enter upon the examination of the *hammadh schoairi* and red lemon. It is very difficult, from the little said of them, to imagine to what variety they ought to be assigned; and I would merely say, with regard to the *cabbad*, that if it is the same which Vansleb calls *kebbad*, in his new book about Egypt, it should be classed with the Adam's apple, seeing that this author describes it as a tree bearing oranges of enormous size, and the Adam's apple, or *citrus decumanus*, has precisely analogous properties.

It is more easy to recognize the races reported by Ebn-el-Awam in his Treatise on Agriculture, where he speaks of the *agrumi* of Seville.

This Spanish-Arab distinguishes four species, calling them *citronier*, *oranger*, *laysamou*, or *yasamou*, or *zambou*, and *limonier*, which names the translator rendered in Spanish, as *cidro naranjo*, *limon*, and *limero*, llamado, (*toronjo* o arbode), *zambo* or *bostamboun*, and which is but the Adam's apple.

("The *atrundj*, the *narendj*, the *yasamou*, called *lambau*, and the *lamoun jaune*, are as one species, and are cultivated in nearly the same manner." EBN-EL-AWAM, p. 314; and elsewhere, "of the planting the *bustamboun*, which is the *zambo*," p. 323.)

Search for the etymology of these names presents difficulties. It would be useless to seek in Arabic or Persian language the origin of *yasamou*, *laysamou*, or *zambou*. Their physiognomy shows that they belong to neither of those tongues, but seems to prove that they will be found only in the languages of China or of Tartary. The Portuguese have adopted the word *zambou*, modifying it to *zambo*. The word *toronjo*, used by the Spaniards for rendering that of *laysamou*, has much affinity with *narendj*, of which it may be a corruption. The word *bostamboun* seems to be composed of the Arabic word *boustan* (garden), and the Persian word *boun* (utility, ornament). In adopting this etymology *bostamboun* might signify *ornament of the garden*, which would perfectly apply to orange trees, and perhaps particularly to that variety having fruit of extraordinary size.

Ebn-el-Awam describes afterwards the different varieties of each species, and we at once recognize the ordinary citron in that which he calls *citron aigre*. (Our bigarade the Arabs have sometimes called *citron rond*, sometimes *citron aigre*, and finally *narendj*. Ebn-Beitar says of it: "The *narendj* is a well known tree, the leaf is

smooth and of a deep green, the fruit is round, and has an acid juice like the citron. The tree, also, closely resembles the citron tree; its flower is white and extremely sweet in odor." AR. MSS. of EBN-BEITAR.) We also recognize the *oranged ponceire*, in that which he calls sweet fruit.

The two first varieties of the *yasamou* are related to our *citrus decumana*, or Adam's apple; and the third, called *toronja chinesca*, appears to be our Chinese citron, (C. M. C. fructu monstruoso aurantianto, GAL. SYN.)

I know not how to determine what is the *orange doree*, which he distinguishes from the ordinary orange, and less still, that called *fleur celeste*; but I clearly recognize a species of lime of Naples in the "lemon of smooth skin, the size of a pigeon's egg," and a sort of large ponceire in the lemon *avirolado*.

The authority of Ebn-el-Awam, appears to prove that these varieties born, in great part, in Syria and Egypt, passed soon into Spain, but not into France and Italy until long afterwards.

One of the causes rendering difficult the recognition of ancient varieties, is the vagueness of descriptions. In those times of ignorance the language of botany was yet unfounded, consequently a person attempting to describe a plant did not select the traits most constant and certain, but each described the parts and peculiarities which most forcibly struck him, according to his manner of seeing, and with terms and expressions which often only confused ideas.

The Arabs, for example, have sometimes designated the orange by the name of *round citron*, and this expression applies equally to a genuine citron which affects this form. But nothing has been more vague than the attempt to express the color of the orange, as it resembles in no degree any known color. It has been indicated by that which was thought to approach it nearest—thus one calls it *jaune* (yellow), another speaks of it as *doree* (golden), another as *rouge* (red), and, finally, some have well adopted the name of *orange color*.

But to picture the idea by describing the fruit, they have made use of very indefinite expressions, causing great uncertainty in these descriptions.

The same inconvenience arises when we try to know the *orange rouge*.

It would appear a suitable name, yet, being sometimes used for indicating ordinary oranges, we find ourselves in uncertainty when wishing to interpret the authors with exactness.

Some have attempted to picture the color of this fruit by the term *vinense* (wine-like). The Ligurians have named it the orange of bloody juice (*arancio sanguigno*).

One finds himself equally embarrassed when trying to express the color of the flowers of the citron and lemon trees. They are shaded with a mixed tint, called by one *red*, by another *violet*, and which is, really, of both these colors.

Perhaps it was but this peculiar color that Ebn-el-Awam wished to designate by the expression *fleur celeste*.

In that case the variety he speaks of is, probably, a hybrid of the orange and lemon, like the one in the Jardin des Plantes at Paris, called *violet* orange tree.

I throw out these conjectures merely to show

that the extraordinary varieties found in books often owe their existence to the vagueness of their names, which represent ideas far removed from truth, and that the number of true varieties is much less than at first would appear.

Matthius Sylvaticus says that the citrine apples (*pomorum citrinorum*, Pand. Med., p. 125,) are four in number, the citron tree (*citrus*), the bigarade tree (*citrangulus*), the lemon tree (*limon*), and the lime (*lima vulgo dicta*), which, apparently, is but the Adam's apple.

Hugo Falcandus talks of *lumies* (*lamias*), and I incline to the opinion that they are nothing else than lemons, because he says they are only fit for seasoning food (*ad condiendis cibis idoneas*). These are all the varieties known in Italy until the middle of the fifteenth century.

The orange tree of sweet fruit appeared about this time, and in Mathioli's day it had been followed by only a very few varieties.

This botanist counts but three varieties of citrons—that of large fruit or citron of Genoa, the citron of Salo, and a third whose fruit is the size of a lemon.

He describes three varieties of orange trees—the sour, the sweet, and a third of mixed taste.

He speaks but of a single species of lemon tree, also of but one species of Adam's apple, that he calls *lomia*.

Augustine Gallo, who wrote at very nearly the same epoch, names only three species of orange trees—sweet, sour, and medium.

He mentions but one citron, that of Salo; only one lemon, the Adam's apple, and the *limonea*, which, he says, is a middle species between the Adam's apple and the lemon, and is, perhaps, a poncire.

It is surprising that Herrera, who lived after these authors, speaks only of the orange, lemon, and *azamboá* or *toronjo*, which is the Adam's apple.

Olivier de Serres says "there are known in Italy four species of orange trees, under the names of orange, citron, lemon, and *limones*, called, also, *ponciles*, and a fifth, called Adam's apple; and of each of these four there are several sorts, differing among themselves rather in size and taste than in species, their form and color remaining nearly always the same." He cites the *cedria*, a kind of lemon, called thus in Provence, and the horned orange or bigarade, much valued for its easy growth, adding, "there are sweet and sour oranges, and others partaking of both savors. The same may be said of lemons, citrons, and ponciles." (OLIV., Theatre of Agriculture, p. 632.)

Such was the state of the family of the agrumi in Europe at the commencement of the sixteenth century, but at this time the commercial relations which extended themselves in the countries where these fruits were indigenous, and the multiplication and use of the seed in the culture of these plants increased prodigiously the number of varieties. Thus we see, one hundred years after, Tauara counts eighty-three species or varieties, and this number has since increased still more rapidly, either in fact or in appearance, until we see the numerous catalogues have become a subject of despair to the most wealthy and most zealous amateur who would form a collection.

It is impossible to follow the history of all these new varieties. Many have surely been brought from India or China; such as the little Chinese, the myrtifolium, the red orange, the monstrous citron, &c. Others have been formed in our own gardens—such as the citron of Florence, the bergamotte, the poncires, the lustrat, and the bizaria. We have seen that this last named was born at Florence in 1644, according to the testimony of a Tuscan naturalist, who has preserved for us the history of its appearing in the gardens of that city.

We have also seen that the poncires form constantly in our gardens, whenever we follow the method of seeding.

This great multiplication of hybrids and varieties was the natural result of this culture.

Leandro Alberti has left us details of its state in Italy, about the year 1523. Navagero, Venetian Ambassador to Charles V., has given us an idea of its progress in Spain; and the relation of the voyage in Provence of Charles IX., by Abel Jouan, enables us to judge of the prodigious multiplication at Hyeres. There remains for us to examine the progress of this culture outside of Europe.

ART. VIII.—*The Citrus Exotic in America—Naturalized after the Discovery by Europeans—Proofs of this fact.*

Perhaps no plant has ever spread with so much rapidity and success as the orange tree. After being propagated a short time in the temperate climes of Europe, they have passed into all the lands where Europeans carried their commerce and conquests.

The Portuguese naturalized them at Madeira, in the Canary isles, and in all their colonies in the Atlantic ocean. The Spaniards carried them to America, where, shortly after, we see those new countries, which possessed none of the trees of the old continent, presenting forests of orange trees.

It is surprising that this vast hemisphere, uniting in its extent nearly all latitudes, had not received from Nature a tree thus suited to its soil, and which has found in its warm, moist climate a position favoring the rich vegetation with which it is endowed.

Had not the original narratives of the first Spanish discoverers of these regions, and the testimony of contemporary historians assured us that America received from Europe these fine trees, one would surely think them indigenous.

But this fact, reported in a very positive manner by all historians of that time, is still further strengthened by proofs not to be doubted without renouncing the principles of just criticism.

We have but to run over the relations by the conquerors and Spanish historians, to see that they never speak of orange trees, although they often give very brilliant descriptions of the delightful gardens of Mexico, especially those of Montezuma. The same silence respecting this tree may be noticed in relations of Peru, Brazil, and other parts of South America.

Now the orange tree is so well naturalized there, that one sees on all sides forests of them; but these forests are in places near habitations, and these trees do not exhibit marks of the great

antiquity characterizing trees indigenous to the New World.

They are generally of a medium size, although their growth is sufficiently vigorous to smother the ancient vegetation, which is overcome on all sides where the orange tree grows.

This single fact convinced one learned traveler that the orange tree did not exist in Paraguay and La Plata until after the discovery of America by Europeans. (See *Voyage in South America* by Felix Azara, bk 1, p. 106.)

But it is unnecessary to resort to conjectures, when one can rely on unchallenged authorities. I shall cite the *Natural History of the Indies* by Acosta, an author contemporary with the first conquests by Europeans; the *History of Peru*, by Garcilasso de la Vega, and the *Natural History of Brazil* by Pison, whose authority is of the greatest weight. The first named thus expresses himself:

"Among the trees carried to America by Europeans not one has taken as rapidly as the orange, lemon, citron, and other trees of this genus.

"There are now in certain parts woods of orange trees. Surprised by this, I asked the inhabitants of one isle, Who has filled the fields with such a great quantity of these trees? They replied that it was due to chance, as the fruits fallen from the trees first planted had given birth to numberless other trees; that thus, and by means of rains carrying in all directions fruit and seeds, were formed the tufted woods seen now. This reply seemed to me very satisfactory.

"It is said that this is the most prosperous tree in the Indies, where one finds no section without orange trees, because this earth is warm and moist, a condition required for the growth of this tree.

"We do not see it in mountainous countries, but in flat lands and near the coast. I have never tasted a conserve of oranges as delicious as is made in these isles." (*History, Natural and Moral, of the Indies*, by Rev. Father Joseph d' Acosta, bk. 4, chap. 31.)

Pison expresses himself in the same way, in speaking of Brazil. "I shall not speak," says he, "of all those plants of which we do not yet know the remedial virtues, or which, carried elsewhere in this country, have been well enough described before me by other writers. Such are the citron, the lemon, the orange, the grenade, the *ble* of Turkey, etc." (GUILIELMI PISONIS. *History, Nat. and Med., of Brazil*, bk. 4, p. 107.)

Garcilasso de la Vega says as much relative to Peru and Chili, and this writer, descended from the Incas, and who was born at Peru soon after the invasion by the Spaniards, ought to have known the state of that country before the conquest. Here are his words: "Before the Spaniards conquered Peru, it is certain that one saw there neither figs, grenades, oranges, citrons, sour or sweet, pears, apples, apricots, quinces, peaches, alberges, nor any of the plums which grow in Spain. But one can say with truth that all these fruits, and many others which I cannot remember, grow there to-day in such abundance that one cares almost nothing for them, any more than other Spanish things which increase much more in those countries of the Indies than in this realm." (*Hist. of the Incas, Kings of Peru*, by the Inca, Garcilasso de la Vega, bk. 9, c. 28.)

Witnesses thus positive leave no doubt upon the origin of the orange trees of America.

That vast hemisphere, whose soil is so fertile, and where is now found nearly all the plants of the Old World, had received from Nature but a certain number of vegetables, which belonged to it, and were unknown to the rest of the world.

Not till after its discovery by Europeans was it enriched with the greater part of those beautiful species given by Nature to countries far removed from it, of which the culture took rapidly in those fine climates.

This fact, whose certainty is so evident, is another convincing proof that each country has had, originally, its species, and that industry alone has so mingled them in one climate as to greatly obscure their origin.

ART. IX.—*The Free Sweet Orange Tree—Prejudices of Agricultural Writers Concerning its Existence—Followed by the Cultivators—Circumstances which have made it Known in Liguria—Advantages of its Culture—Conclusion.*

It would be interesting to those investigating the history of the citrus, to know whether the orange, naturalized in America, was the sweet orange or the bigarade. I have uselessly read the writings upon the subject for the purpose of learning the truth; none of them speak in a manner to enlighten us. Yet, notwithstanding this silence, all agree that the sweet orange was carried there at the same time as the bigarade, or, at least, soon after.

The woods seen there now are, in part, of this species, and it is natural that, being cultivated in Europe, it should be taken there by preference.

I have several times consulted planters of St. Domingo upon the nature of the orange trees of that country.

According to their reports it would appear that the sweet-fruited orange tree is still in that island—only a garden plant—multiplied by graft, and having no thorn. The bigarade tree, on the contrary, (called by them *bitter oranges*), is found in the woods in a savage state; but the Spanish colonists have assured me that upon the Continent one may see woods of the two species.

It is surprising that the success of those plantations which renew themselves by seed, and give sweet fruit without being grafted, have not enlightened Europeans and led them to multiply these trees by seed. I have no means of ascertaining whether this method is known in Portugal. As to Spain I think it is not practiced there. An attentive examination of the sweet orange trees of that country has satisfied me that all are grafted.

It is certain that the method is still ignored in Sicily and Naples, and not more than half a century has elapsed since its introduction in Liguria.

I do not know, indeed, of any writer on agriculture who has spoken of the sweet orange as a mother-species, capable of perpetuating and reproducing itself by its own seed. All speak only of its multiplication by grafts, or by layers, and the greater part have given methods for moderating the harshness of free fruits by means of infusions of the seed, or other similar proceedings.

We read this, not only in the agriculture of Porta, Charles Etienne, Olivier de Serres, Rozier, Gallo, &c., but again in that of Herrera, himself a Spaniard, and one who should have known the properties of this tree in America. Olivier de Serres expresses himself in these words: "It is requisite to graft these trees in order to make them produce fruits entirely good and delightful, without which means they could not be made to do so." (Theatre of Agri., p. 632.)

Tanara, whose writings date from a century later, is the first to reject all these methods as popular errors, but does not recognize the existence of a free species of sweet fruit, and advises recourse to the graft for multiplying this species, "because [these are his words] the natural orange delays twelve or thirteen years to give fruit, and only yields a bad quality." This opinion is followed by all the best writers, and even by the more modern ones.

Ferraris is the only author who has known of the existence of the orange tree of sweet fruit growing from seed. This writer, the first to examine deeply into the culture of this tree, lived in a time (1646) when this method, already spread in America, had probably passed into Portugal and other parts of Europe. He ought, then, to have had an idea of it. Nevertheless, he speaks of it as a peculiarity accorded by Nature to some of the more favored climates, as the Philippine isles and China (Fer., pp. 44, 450), and he counsels European gardeners to supply by graft the defect of climate. Thus, "in some countries, Nature, more adroit, renders art useless, because the seed of domesticated orange trees give abundantly of sweet fruit without need of being grafted. But this same benefit, accorded not by the most propitious Nature to every climate, admonishes the gardener of the necessity of correcting by graft the natural defect of the wild orange." (Fer.-Hesperides, p. 450.) He also tells of some specimens seen at Corfu, and at Rome, but regards them as phenomena, seeing that he establishes as a maxim that the most perfect seed of the sweetest orange will yield only plants bearing sour and wild fruit, which require to be improved by the graft. (Fer., p. 450.)

Such is the force of habit and prejudice; when an opinion has taken root in the mind of men, it is not sufficient for its destruction that Nature reveals herself by her operations. Prejudice will long contend against belief of facts; and those who dare first to attack these prejudices, must expect censure, and be content to relinquish the honor of their discoveries during life.

More than a century has passed since Ferraris remarked that there were climates where the sweet orange reproduced itself from seed, and still the prejudice in favor of the graft exists in the minds of the greater number of agricultural writers.

It is by means of the graft, or by cuttings, that this tree is still multiplied at Salò, in Sicily, and in Naples, and always upon citron trees. It is by graft upon the bigarade that the sweet orange is multiplied at Seville, at Valencia, in Crete, at Nice, and in Provence.

M. Vacca, a land-owner at Finale, and owner of many orange trees, when at Palermo in 1790, was at the country seat of the Marquis Airoldi, then President of Sicily. Seeing only small

trees in these gardens, as well as in all parts of the isle, he expressed astonishment, and gave so glowing a description of the Finale orange trees, that he was scarcely believed. But the details given by him were so positive, that M. Airoldi, a great amateur of oranges, and a well informed man, decided to make a voyage to Finale, expressly to see our plantations. He came there in 1793-94, and was so surprised by the beauty of our trees, that, on returning to Sicily, he took with him a family of cultivators, in order to conduct his plantations according to the method in Finale.

I know not whether he was made to see that the beauty of these plants was only due to the nature of the tree, which, coming from seed, is more vigorous; nor whether he afterwards introduced at Palermo the culture of free trees. I only know that even at that period the orange at Sicily was but a grafted tree, and that the most beautiful ones there gave only twelve or fifteen hundred oranges each.

This custom of grafting had in its favor several circumstances. The grafted orange gave fruit almost immediately, while a free tree produced fruit only after twelve or fifteen years; this, of itself, would appear important enough to give the preference to the common method. Many other reasons united to sustain it. From the first, it was supposed that the bigarade resisted cold better than the sweet orange (*nec hiemem reformidant utpote habitu calidiora*. Fer., p. 451), and this advantage seemed very important. Afterwards it was said that it had the real advantage of submitting more readily to cultivation in boxes, because it grew more slowly, and remained smaller, than the free orange tree. Finally, the custom of grafting suited the views of the speculating gardeners, as well as amateurs. Both had no other object than to be assured of the varieties they possessed, and which they desired to preserve. The success of the seed was distant and uncertain.

Thus it could interest none but the philosopher desirous to study Nature in her operations; and he would need, in addition to an absorbing love for science, means and leisure in order to devote to this study land and time.

Thus we see why there has been such delay in learning the nature of this species, which, during a number of years, has existed but precariously upon a different species.

But at length chance led to this discovery. The frost of 1709 caused the destruction of all the orange trees in Liguria. To form the seed-beds of the nurserymen the seeds of the sweet orange were used, this being the only fruit sent from southern districts for consumption in Italy. These plants were condemned by the gardeners to be grafted, the same as bigarades had been, but the frost, following that of 1709, destroyed many of these grafts.

Ordinarily, they grafted anew the vigorous sprouts from the trunk. Some were, however, neglected; and these gave, after some years, very fine oranges.

This phenomenon excited the surprise and attracted the attention of several cultivators. They experimented by allowing many of these rejetons to grow without grafting, until a constant and uniform success at length convinced

them that one might have sweet oranges without recourse to the graft.

I have, at Finale, a country-seat, where, in 1718, my grandfather planted a great number of orange trees. The plants, all grafted, were furnished, according to custom, by the nurserymen of Nervi. Placed in these gardens, they made prodigious increase, so that every one was astonished, and imputed this rapid growth to the fresh earth brought to form these artificial gardens, or to the happy exposure of the field, and the abundance of water ornamenting and fertilizing the place.

Peculiar circumstances, which I propose to speak of in the second part of this work, secured them from the frosts occurring in that century (notably, that murderous freeze of 1763,) until 1782, when they were frozen to the stumps. Cut close to the earth, they grew in the spring vigorously, and the sprouts, known to be free, were raised without being grafted.

Unfortunately, a large number perished by the frost of 1799. Yet several stalks escaped, and each of them yielded, in 1806, as many as three thousand oranges.

Never before the frost did they bear so large a number, owing to the fact that then nothing was free but the foot. The branches grew from the grafts, and did not develop as well as free trees. I shall enlarge upon this fact in the chapters wherein I treat of culture and of frosts.

It is necessary to state that the *rejetons* (sprouts from the roots) of a tree already adult bear fruit at the end of three years, sometimes even sooner. This has facilitated the observation just spoken of.

It is not easy to forget or neglect a small plant, leaving it ungrafted during a sufficient time for seeing it fruit, because it reaches this point only after fifteen or twenty years, but a *rejeton* is, necessarily, left to grow and gain strength for three or four years, before a choice is made of the most suitable for grafting, and in this interval the *rejeton* will certainly put forth flowers, which set themselves very easily and give fruit. It is precisely this which has brought about the discovery in question.

The observation respecting free trees, made for the first time at Finale, drew the attention of all the amateurs, and they formed immediately in this country many nurseries of sweet orange trees. After the frost of 1763 these plantations were extended; especially where old trees had perished, the free trees were substituted.

The success of these plantations justified at once the method that was being tried. Not a single one of these plants failed to bear sweet fruit.

There was the satisfaction also of seeing that these free trees displayed a vigor in their vegeta-

tion, and a rapid increase, such as had never been seen in the old plantations. The gardens of Finale were soon filled with this new race, called seed orange trees (*arancio di grana*), and little by little it was also adopted in neighboring districts, chiefly at Savona, at Pietra, and at Spezzia, where they now raise only free trees.

The orange trees of Finale are perhaps the finest to be seen in Europe. Those of Sicily bear very sweet fruit, but not a tree produces more than twelve or fifteen hundred. The trees of the Archipelago, of Salo, of Nice, and of Hyeres, yielded no more than those of Sicily. I have seen those of Murcia, of Tariffa, and of Seville. They seem to me to be no larger than those at Finale.

The monks of *Los Remedios*, who have, perhaps, the finest garden in Andalusia, assured me that they have gathered from their trees as many as 5,000 oranges each, but nowhere have I seen as large fruit as in the neighborhood of the city of Finale.

The garden of M. Alizeri contains a hundred sweet trees, the smallest of which gives from twenty-five hundred to three thousand oranges. More than half of them bear from three to four thousand.

One sees many of these trees in the garden of M. Aicardi, from which have been plucked six thousand oranges, and in M. Piaggia's garden there is one, distinguished as having yielded eight thousand. This beautiful tree grows to the height of nine metres (nearly thirty feet). Its branches, which form a globe, and descend even to the ground, present a circumference of thirty-four metres (more than one hundred and eleven feet). The stem, still young and vigorous, is nearly five feet in circumference.

It is solely by this method (of free trees) that the culture of the orange has been carried to a degree of success rarely seen in exotic plants. In less than sixty years this has advanced the naturalization of the tree much more than grafting and other methods had done in the space of several centuries, and offers an example of what we should expect of all vegetation multiplied by this means.

It has not been without interest, this search to ascertain by what steps this result has been reached, and what circumstances had made it known.

This was the task I imposed upon myself, and which, I think, I have accomplished in this chapter.

I am happy if my investigations shall aid the progress of agriculture, which is the most substantial source of wealth, and the basis of the prosperity of nations.

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